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MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS

JANUARY—JUNE.

VOL. I.

Far, however, be it from me to advocate the retention, within the circumference of our Island, of the Arts and Sciences which are our best possessions and our brightest ornaments. Over the Western World, now in her sublime career of Independence calling for their aid, I would have them liberally diffused: thus, indeed, in part atoning for those wrongs which followed in the train of the genius and enterprize of COLUMBUS. Let European arts and European sciences freely cross the Western main, to enrich the gay savannahs, and the vast mountain plains, in regions distinguished alike by their sublimity and inexhaustible fertility, until all that can be wafted by the winds, or that can be impelled by all-conquering steam, excepting European vices, and European warriors, may be found,

"Where Andes, giant of the western star,
Looks from his throne of clouds o'er half the world."

[*Extract from Dr. Birkbeck's Inaugural Address.*]

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MDCCCXXXIII.

PREFACE.

That the present age is an era of improvement must be obvious to all who watch the progress of education, and the various ingenious inventions that are continually offered for the approbation and patronage of the public. An unprecedented spirit of inquiry and thirst for knowledge has of late years sprung up in almost every part of this extensive country, and already the benefits derived to the Union, by this increasing thirst for knowledge of every description, are exemplified by the growing worth and growing intelligence of its citizens. To give an impetus to this desire for useful information, as well as to afford an opportunity to those who would communicate their ideas of inventions and improvements, the Mechanics' Magazine was projected, and we have now to congratulate our subscribers on the completion of the first volume. How far we have redeemed our pledge to them on its first announcement, we shall leave to our candid readers to judge—conscious that it has been our aim to do so, and believing that in no one instance have they been unfulfilled.

In all countries the importance of artizans in the scale of society has been undervalued. Those who have led on armies successfully, either in defence of their country, or who have waged war in consequence of some real or supposed grievance, as well as those who have promulgated laws which were considered beneficial to the government under which they lived, have been held up to the admiration of the world; and the benefits they have bestowed upon society form

"The theme, the admiration, and the song,"

of poets, historians, and philosophers. Yet there is no instance on record where the first constructor of a new machine is considered in the same view; he is looked upon as a mere projector of a useful invention, which is to be improved upon and brought to perfection by others. This should not be so: surely Robert Fulton, James Watt, Eli Whitney, and a host of others, deserve the thanks of the people of all nations for their inventions, in an equal degree to those who have promulgated laws, however beneficial they may operate to mankind at large; and much more so than those who have been engaged in a fierce, uncalled for, and relentless war, in many cases for the purpose of upholding tyranny and oppression.

It is a curious fact that the power of combining machines and constructing poetry have frequently been united in the same individual. This has been overlooked by the great bulk of mankind. We have the authority of Mr. Stuart Meikleham, in his account of Steam Engines, for the following facts: Hooke made verses as well as machines; and

when he presented thirty-seven different projects for flying, had his attention been directed to express his thoughts in metre, he had previously shown a facility for describing the glories of his mistress' eye-brows in as many sonnets. Lord Worcester also made verses —Sir Samuel Moreland indited love songs—Watt, in his youth, was a rhymester—Arkwright was famous for verses, which cut as keen as his razors—Rennie chaunted his own lyrics, which were distinguished for their spirit and taste—and Telford, while building rough stone-fences as a journeyman mason, was an esteemed contributor to the poetic corner of the Scot's Magazine; Sir W. Congreve wrote poems, as also Sir Christopher Wren—Sir Humphry Davy wrote his Address to St. Michael's Mount, in the heroic measure, long before he invented his safety-lamp—Dr. Cartwright distinguished himself for poetical compositions many years before he invented the power-loom—Milton's hell-gates move on more than mortal hinges; and his war chariots may yet form a subject for illustration in a mechanical college. The horse of Epeus has lately been adduced as an early locomotive! Homer's description of cars shows that he had an eye for beauty in carts which would have carried them to perfection; Ferdousi, of Persia, has spun one hundred and fifty thousand couplets, and has found leisure to construct several complicated pieces of machinery of his own invention—among them are spinning jennies, paper machines, steam engines, and a printing press.

These are a few instances, quoted for two reasons: the one is to show the important station in society some mechanics have held, and the other for the purpose of proving the fallacy of the argument often advanced, that the mere inventor takes no interest in any thing but his own inventions. Such, it is evident, cannot be advanced as a general rule; indeed, instances of this kind are rare to be found. The members of the numerous Mechanics' Institutions, in this country and Europe, do not rest satisfied with lectures on machinery; they listen with avidity to those on natural philosophy, chemistry, anatomy, poetry, and are eager to be instructed in the various languages, as well as in the higher orders of literature.

Of Mechanics' Institutions, in this volume, we have said but little, but it is only because we have not been able to obtain accurate information of the state of them in the various sections of the Union; to the secretary or members of any of them we shall feel obliged by their forwarding (postage free) an account of their proceedings, either of the last year or since their formation. In those districts where institutions for the promotion of science are not formed, we earnestly say, MAKE A BEGINNING.

Many will say there are only a few of us, and the expenses would be too heavy for our means—to such we would say, in the language of a contemporary, "If you cannot procure a library, borrow a pamphlet, or a tract, upon 'useful knowledge,' and meet and read and converse upon its contents. If you cannot erect or purchase a building, rent or borrow a private room, till you can procure a better. If you cannot procure a laboratory and a complete set of chemical apparatus, borrow from the kitchen, a pitcher, a bowl, and a tumbler, and from the physician get a phial and an acid, and take the examples of a Franklin, a

Priestley, a Black, or a Davy, to direct your efforts. If you cannot procure an orrery, intended to illustrate at one view the numerous and complicated motions of all the bodies in the solar system, but fitted to confuse and bewilder the mind, take an orange or an apple and show simply and clearly the shape, surface, and motions of the earth.

"If you have not a complete set of mechanical powers neatly constructed, and finely polished by the hand of a physical instrument-maker, use a cane to show the principles of the lever, and the first circular pulley within reach to prove that the lever, the pully, and the wheel-axle, are but varieties of the same thing. If you cannot give lectures with logical arrangement, rhetorical figures, and rounded sentences, congratulate yourselves that ideas are better than sounds, and facts than flourishes. If you cannot learn in detail all the minutiæ in a complete system of science, prove by some simple experiment a single *practical* principle, which you can constantly witness in the motion of limbs, in a wheel, a plough, or an-edged tool. If every person cannot be a profound or a critical scholar, he may be an enlightened, respectable, and useful citizen."

To our patrons we would say, that the future numbers shall in no way be inferior to those of the present volume; indeed, every effort shall be made to render them more worthy their notice. May we solicit their recommendation? They can, with confidence, say, that in it will be found much instruction and amusement, and not one line that can offend the eye of the most strictly moral and religious man; indeed, where an opportunity has occurred to revert to the sublime truths of Christianity, and to the all-wise Creator of the Universe, it has been embraced—for

What is philosophy, if it impart
Irreverence for the Deity, or teach
A mortal man to set his judgment up
Against his Maker's will? The Polygar
Who kneels to sun or moon, compared with him
Who thus perverts the talents he enjoys,
Is the most bless'd of men!
* * * * * *
——————————shalt thou
Lift up thy thankless spirit, and contemn
His heavenly providence! Deluded fool,
Even now the thunderbolt is winged with death,
Even now thou totterest on the brink of hell!—[*Henry Kirk White.*]

New-York, June 30, 1833.

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*** Those articles that are marked thus † have reference to Mr. Babbage's work on Machines and Manufactures, which in this volume is called the "Appendix."*

MECHANICS' MAGAZINE,

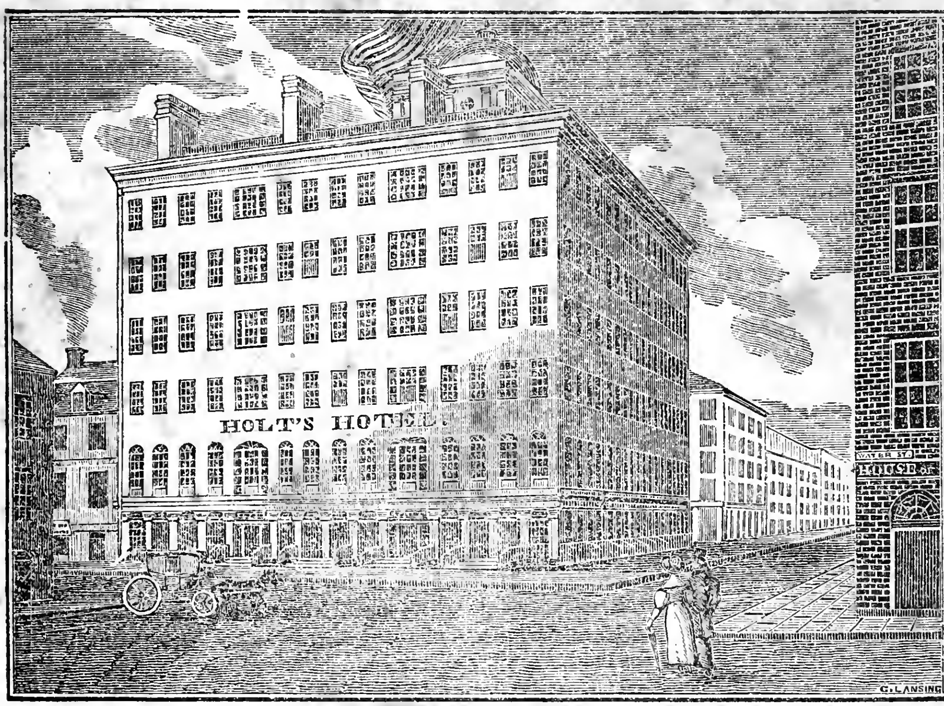
AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME I.] JANUARY, 1833. [NUMBER 1.

The introduction of new inventions seemeth to be the very chief of all human actions. The benefits of new inventions may extend to all mankind universally, but the good of political achievements can respect but some particular cantons of men. These latter do not endure above a few ages—the former, forever. Inventions may make all men happy without either injury or damage to any one single person. Furthermore new inventions are, as it were, new erections and imitations of God's own works.

BACON.



[*For description, see page 7.*]

TO THE READER.

In offering to the notice of the public the first number of the "MECHANICS' MAGAZINE, AND REGISTER OF INVENTIONS AND IMPROVEMENTS," we feel that we are rendering a service to that important and intelligent part of the community, the Mechanics of the United States, by introducing to them a journal so cheap as to be within the reach of all,—and so useful, that we trust few will be satisfied to be without it.

We look with confidence to the artisan for that patronage which it shall be our constant aim to merit. Our Magazine will consist of a digested selection of the best articles from numerous scientific and literary works published in Europe, accompanied by graphic illustrations on wood, many of which are almost unknown in this country. Its pages will always be open for the communications of the intelligent of all classes, but to the practical artisan we trust we shall be indebted for many useful

accounts of their experiments, inventions, and discoveries; and we most earnestly solicit their friendly aid and correspondence. It shall be our constant endeavor to be useful, but where we can blend information with amusement, we shall not fail to embrace the opportunity. We are convinced that science can be conveyed in an interesting and amusing form, to a much greater extent than has yet been attempted in this country; and our readers, we are sure, will concur in that opinion after they have perused with attention the following eloquent remarks from the pen of HENRY BROUGHAM, *Lord High Chancellor of England,* on the "Pleasures and Advantages of Science." These remarks are so congenial with our own feelings, and so well describe the principles upon which it is our wish and intention to be guided in conducting this journal, that we insert them with much pleasure —convinced that they will form a far better introductory notice to our readers, than any arguments that we could possibly advance.

ON THE PLEASURES AND ADVANTAGES OF SCIENCE.—Man is composed of two parts, body and mind, connected indeed together, but wholly different from one another. The nature of the union—the part of our outward and visible frame in which it is peculiarly formed—or whether the soul be indeed connected or not with any particular portion of the body, so as to reside there—are points as yet wholly hid from our knowledge, and which are likely to remain forever concealed. But this we know, as certainly as we can know any truth, that there is such a thing as the *Mind;* and that we have at the least as good proof of its existence, independent of the Body, as we have of the existence of the Body itself. Each has its uses, and each has its peculiar gratifications. The bounty of Providence has given us outward senses to be employed, and has furnished the means of gratifying them in various kind, and in ample measure. As long as we only taste those pleasures according to the rules of prudence and of our duty, that is, in moderation for our own sakes, and in harmlessness towards our neighbors, we fulfil rather than thwart the purpose of our being. But the same bountiful Providence has endowed us with the higher nature also—with understandings, as well as with senses—with faculties that are of a more exalted order, and admit of more refined enjoyments, than any to which the bodily frame can minister; and by pursuing such gratifications, rather than those of mere sense, we fulfil the most exalted ends of our creation, and obtain both a present and a future reward. These things are often said, but they are not therefore the less true, or the less worthy of deep attention. Let us mark their practical application to the occupations and enjoyments of all branches of society, beginning with those who form the great bulk of every community, the working classes, by what names soever their vocations may be called—professions, arts, trades, handicrafts, or common labor.

1. The first object of every man who has to depend upon his own exertions must needs be to provide for his daily wants. This is a high and important office; it deserves his utmost attention; it includes some of his most sacred duties, both to himself, his kindred, and his country; and although, in performing this task, he is only influenced by a regard to his own interest, or by his necessities, yet it is an employment which renders him truly the best benefactor of the community he belongs to. All other pursuits must give way to this; the hours which he devotes to learning must be after he has done his work; his independence, without which he is not fit to be called a man, requires first of all that he should have insured for himself, and those dependent on him, a comfortable subsistence, before he can have a right to taste any indulgence, either of his senses or of his mind; and the more he learns—the greater progress he makes in the sciences—the more will he value that independence, and the more will he prize the industry, the habits of regular labor, whereby he is enabled to secure so prime a blessing.

In one view, it is true, the progress which he makes in science may help his ordinary exertions, the main business of every man's life. There is hardly any trade or occupation in which useful lessons may not be learnt by studying one science or another. The necessity of science to the more liberal professions is self-evident; little less manifest is the use to their members of extending their knowledge beyond the branches of study with which their several pursuits are peculiarly conversant. But the other departments of industry derive hardly less benefit from the same source. To how many kinds of workmen must a knowledge of Mechanical Philosophy be useful! To how many others does Chemistry prove almost necessary! Every one must with a glance perceive that to engineers, watch-makers, instrument-makers, bleachers, and dyers, those sciences are most useful, if not necessary. But carpenters and

masons are surely likely to do their work better for knowing how to measure, which Practical Mathematics teaches them, and how to estimate the strength of timber, of walls, and of arches, which they learn from Practical Mechanics; and they who work in various metals are certain to be the more skilful in their trades for knowing the nature of those substances, and their relations to both heat and other metals, and to the airs and liquids they come in contact with. Nay, the farm-servant, or day-laborer, whether in his master's employ, or tending the concerns of his own cottage, must derive great practical benefit—must be both a better servant, and a more thrifty, and therefore comfortable, cottager, for knowing something of the nature of soils and manures, which Chemistry teaches, and something of the habits of animals, and the qualities and growth of plants, which he learns from Natural History and Chemistry together. In truth, though a man be neither mechanic nor peasant, but only one having a pot to boil, he is sure to learn from science lessons which will enable him to cook his morsel better, save his fuel, and both vary his dish and improve it. The art of good and cheap cookery is intimately connected with the principles of chemical philosophy, and has received much, and will yet receive more, improvement from their application. Nor is it enough to say, that philosophers may discover all that is wanted, and may invent practical methods, which it is sufficient for the working man to learn by rote, without knowing the principles. He never will work so well if he is ignorant of the principles,—and for a plain reason: if he only learn his lesson by rote, the least change of circumstances puts him out. Be the method ever so general, cases will always arise in which it must be varied in order to apply; and if the workman only knows the rule without knowing the reason, he must be at fault the moment he is required to make any new application of it. This, then, is the *first* use of learning the principles of science: it makes men more skilful, expert, and useful, in the particular kinds of work by which they are to earn their bread, and by which they are to make it go far, and taste well, when earned.

2. But another use of such knowledge to handicraftsmen is equally obvious: it gives every man a chance, according to his natural talents, of becoming an improver of the art he works at, and even a discoverer in the sciences connected with it. He is daily handling the tools and materials with which new experiments are to be made; and daily witnessing the operations of Nature, whether in the motions and pressures of bodies, or in their chemical actions on each other. All opportunities of making experiments must be unimproved, all appearances must pass unobserved, if he has no knowledge of the principles; but with this knowledge he is more likely than another person to strike out something new which may be useful in art, or curious or interesting in science. Very few great discoveries have been made by chance and by ignorant persons, much fewer than is generally supposed. It is commonly told of the steam-engine, that an idle boy being employed to stop and open a valve, saw that he could save himself the trouble of attending and watching it, by fixing a plug upon a part of the machine which came to the place at the proper times, in consequence of the general movement. This is possible, no doubt, though nothing very certain is known respecting the origin of the story; but improvements of any value are very seldom indeed so easily found out, and hardly another instance can be named of important discoveries so purely accidental. They are generally made by persons of competent knowledge, and who are in search of them. The improvements of the steam-engine by Watt resulted from the most learned investigation of mathematical, mechanical, and chemical truths. Arkwright devoted many years, five at the least, to his invention of spinning-jennies, and he was a man perfectly conversant in every thing that relates to the construction of machinery: he had minutely examined it, and knew the effects of each part, though he had not received any thing like a scientific education. If he had, we should in all probability have been indebted to him for scientific discoveries, as well as practical improvements. The most beautiful and useful invention of late times, the safety-lamp, was the reward of a series of philosophical experiments made by one thoroughly skilled in every branch of chemical science. The new process of refining sugar, by which more money has been made in a shorter time, and with less risk and trouble, than was ever perhaps gained from an invention, was discovered by a most accomplished chemist,* and was the fruit of a long course of experiments, in the progress of which, known philosophical principles were constantly applied, and one or two new principles ascertained. But in so far as chance has any thing to do with discovery, surely it is worth the while of those who are constantly

* Edward Howard, brother of the Duke of Norfolk.

working in particular employments to obtain the knowledge required, because their chances are greater than other people's of so applying that knowledge as to hit upon new and useful ideas; they are always in the way of perceiving what is wanting, or what is amiss in the old methods; and they have a better chance of making the improvements. In a word, to use a common expression, they are in the way of good luck; and if they possess the requisite information, they can take advantage of it when it comes to them. This, then, is the *second* great use of learning the sciences: it enables men to make improvements in the arts, and discoveries in philosophy, which may directly benefit themselves and mankind.

3. Now, these are the *practical* advantages of learning; but the *third* benefit is, when rightly considered, just as practical as the other two—the pleasure derived from mere knowledge, without any view to our own bodily enjoyments; and this applies to all classes, the idle as well as the industrious, if, indeed, it be not peculiarly applicable to those who enjoy the inestimable blessing of having time at their command. Every man is by nature endowed with the power of gaining knowledge; and the taste for it, the capacity to be pleased with it, forms equally a part of the natural constitution of his mind. It is his own fault, or the fault of his education, if he derives no gratification from it. There is a satisfaction in knowing what others know—in not being more ignorant than those we live with: there is a satisfaction in knowing what others do not know—in being more informed than they are. But this is quite independent of the pure pleasure of knowledge—of gratifying a curiosity implanted in us by Providence, to lead us towards the better understanding of the universe in which our lot is cast, and the nature wherewithal we are clothed. That every man is capable of being delighted with extending his information upon matters of science, will be evident from a few plain considerations.

Reflect how many parts of the reading, even of persons ignorant of all sciences, refer to matters wholly unconnected with any interest or advantage to be derived from the knowledge acquired. Every one is amused with reading a story; a romance may divert some, and a fairy tale may entertain others; but no benefit beyond the amusement is derived from this source; the imagination is gratified; and we willingly spend a good deal of time and a little money in this gratification, rather than in resting after fatigue, or in any other bodily indulgence. So we read a newspaper, without any view to the advantage we are to gain from learning the news, but because it interests and amuses us to know what is passing. One object, no doubt, is to become acquainted with matters relating to the welfare of the country; but we also read the occurrences which do little or not at all regard the public interests, and we take a pleasure in reading them. Accidents, adventures, anecdotes, crimes, and a variety of other things, amuse us, independent of the information respecting public affairs, in which we feel interested as citizens ot the state, or as members of a particular body. It is of little importance to inquire how and why these things excite our attention, and wherefore the reading about them is a pleasure: the fact is certain; and it proves clearly that there is a positive enjoyment in knowing what we did not know before; and this pleasure is greatly increased when the information is such as excites our surprise, wonder, or admiration. Most persons who take delight in reading tales of ghosts, which they know to be false, and feel all the while to be silly in the extreme, are merely gratified, or rather occupied, with the strong emotions of horror excited by the momentary belief, for it can only last an instant. Such reading is a degrading waste of precious time, and has even a bad effect upon the feelings and the judgment.* But true stories of horrid crimes, as murders, and pitiable misfortunes, as shipwrecks, are not much more instructive. It may be better to read these than to sit yawning and idle—much better than to sit drinking or gaming, which, when carried to the least excess, are crimes in themselves, and the fruitful parents of many more. But this is nearly as much as can be said for such vain and unprofitable reading. If it be a pleasure to gratify curiosity, to know what we were ignorant of, to have our feelings of wonder called forth, how pure a delight of this very kind does Natural Science hold out to its students! Recollect some of the extraordinary discoveries of Mechanical Philosophy. How wonderful are the laws that regulate the motions of fluids! Is there any thing in all the idle books of tales and

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* *Childrens' Books* have at all times been made upon the pernicious plan of exciting wonder, generally horror, at whatever risk. The folly and misery occasioned by this error, it would be difficult to estimate. The time may come when it will be felt and understood. At present, the inveterate habits of parents and nurses prevent children from benefitting by the excellent lessons of Mrs. Barbauld and Miss Edgeworth.

horrors more truly astonishing than the fact, that a few pounds of water may, by mere pressure, without any machinery—by merely being placed in a particular way—produce an irresistible force? What can be more strange, than that an ounce weight should balance hundreds of pounds, by the intervention of a few bars of thin iron? Observe the extraordinary truths which Optical Science discloses. Can any thing surprise us more, than to find that the color of white is a mixture of all others—that red, and blue, and green, and all the rest, merely by being blended in certain proportions, form what we had fancied rather to be no color at all, than all colors together! Chemistry is not behind in its wonders. That the diamond should be made of the same material with coal; that water should be chiefly composed of an inflammable substance; that acids should be, for the most part, formed of different kinds of air, and that one of those acids, whose strength can dissolve almost any of the metals, should consist of the self-same ingredients with the common air we breathe; that salts should be of a metalic nature, and composed, in great part, of metals, fluid like quicksilver, but lighter than water, and which, without any heating, take fire upon being exposed to the air, and by burning from the substance so abounding in saltpetre and in the ashes of burnt wood:—these, surely, are things to excite the wonder of any reflecting mind—nay, of any one but little accustomed to reflect. And yet these are trifling when compared to the prodigies which Astronomy opens to our view: the enormous masses of the heavenly bodies; their immense distances; their countless numbers; and their motions, whose swiftness mocks the uttermost efforts of the imagination.

Akin to this pleasure of contemplating new extraordinary truths, is the gratification of a more learned curiosity, by tracing resemblances and relations between things which, to common apprehension, seem widely different. Mathematical science, to thinking minds, affords this pleasure in a high degree. It is agreeable to know that the three angles of every triangle, whatever be its size, howsoever its sides may be inclined to each other, are always, of necessity, when taken together, the same in amount: that any regular kind of figure whatever, upon the one side of a right-angled triangle, is equal to the two figures of the same kind upon the two other sides, whatever be the size of the triangle; that the properties of an oval curve are extremely similar to those of a curve, which appears the least like it of any, consisting of two branches of infinite extent, with their backs turned to each other. To trace such unexpected resemblance is, indeed, the object of all philosophy; and experimental science, in particular, is occupied with such investigations, giving us general views, and enabling us to explain the appearances of nature—that is, to show how one appearance is connected with another. But we are now considering only the gratification derived from learning these things.

It is surely a satisfaction, for instance, to know that the same thing, or motion, or whatever it is, which causes the sensation of heat, causes also fluidity, and expands bodies in all directions; that electricity, the light which is seen on the back of a cat when slightly rubbed on a frosty evening, is the very same matter with the lightning of the clouds; that plants breathe like ourselves, but differently by day and by night; that the air which burns in our lamps enables a balloon to mount, and causes the globules of the dust of plants to rise, float through the air, and continue their race—in a word, is the immediate cause of vegetation. Nothing can at first view appear less like, or less likely to be caused by the same thing, than the processes of burning and of breathing—the rust of metals and burning—an acid and rust—the influence of a plant on the air it grows in by night, and of an animal on the same air at any time, nay, and of a body burning in that air; and yet all these are the same operation. It is an undeniable fact, that the very same thing which makes the fire burn, makes metals rust, forms acids, and enables plants and animals to breathe; that these operations, so unlike to common eyes, when examined by the light of science, are the same—the rusting of metals—the formation of acids—the burning of inflammable bodies—the breathing of animals—and the growth of plants by night. To know this is a positive gratification. Is it not pleasing to find the same substance in various situations extremely unlike each other; to meet with fixed air as the produce of burning, of breathing, and of vegetation; to find that it is the choke-damp of mines, the bad air in the grotto at Naples, the cause of death in neglecting brewers' vats, and of the brisk and acid flavor of Seltzer and other mineral springs? Nothing can be less like than the working of a vast steam-engine, of the old construction, and the crawling of a fly upon the window. Yet we find these two operations are performed by the same means, the weight of the atmosphere, and

that a sea-horse climbs the ice-hills by no other power. Can any thing be more strange to contemplate? Is there in all the fairy tales that ever were fancied any thing more calculated to arrest the attention and to occupy and to gratify the mind, than this most unexpected resemblance between things so unlike to the eyes of ordinary beholders? What more pleasing occupation than to see uncovered and bared before our eyes the very instrument and the process by which Nature works? Then we raise our views to the structure of the heavens; and are again gratified with tracing accurate but most unexpected resemblances. Is it not in the highest degree interesting to find, that the power which keeps this earth in its shape, and in its path, wheeling upon its axis round the sun, extends over all the other worlds that compose the universe, and gives to each its proper place and motion; that this same power keeps the moon in her path round our earth, and our earth in its path round the sun, and each planet in its path; that the same power causes the tides upon our globe, and the peculiar form of the globe itself; and that, after all, it is the same power which makes a stone fall to the ground? To learn these things, and to reflect upon them, occupies the faculties, fills the mind, and produces certain as well as pure gratification.

But if the knowledge of the doctrines unfolded by science is pleasing, so is the being able to trace the steps by which those doctrines are investigated, and their truth demonstrated: indeed you cannot be said, in any sense of the word, to have learnt them, or to know them, if you have not so studied them as to perceive how they are proved. Without this you never can expect to remember them long, or to understand them accurately; and that would of itself be reason enough for examining closely the grounds they rest on. But there is the highest gratification of all, in being able to see distinctly those grounds, so as to be satisfied that a belief in the doctrines is well founded. Hence to follow a demonstration of a grand mathematical truth—to perceive how clearly and how inevitably one step succeeds another, and how the whole steps lead to the conclusion—to observe how certainly and unerringly the reasoning goes on from things perfectly self-evident, and by the smallest addition at each step, every one being as easily taken after the one before as the first step of all was, and yet the result being something not only far from self-evident, but so general and strange, that you can hardly believe it to be true, and are only convinced of it by going over the whole reasoning—this operation of the understanding, to those who so exercise themselves, always affords the highest delight. The contemplation of experimental inquiries, and the examination of reasoning founded upon the facts which our experiments and observations disclose, is another fruitful source of enjoyment, and no other means can be devised for either imprinting the results upon our memory, or enabling us really to enjoy the whole pleasures of science. They who found the study of some branches dry and tedious at the first, have generally become more and more interested as they went on; each difficulty overcome gives an additional relish to the pursuit, and makes us feel, as it were, that we have by our work and labor established a right of property in the subject. Let any man pass an evening in vacant idleness, or even in reading some silly tale, and compare the state of his mind when he goes to sleep or gets up next morning with its state some other day, when he has passed a few hours in going through the proofs, by facts and reasoning, of some of the great doctrines in Natural Science, learning truths wholly new to him, and satisfying himself by careful examination of the grounds on which known truths rest, so as to be not only acquainted with the doctrines themselves, but able to show why he believes them, and to prove before others that they are true; he will find as great a difference as can exist in the same being—the difference between looking back upon time unprofitably wasted, and time spent in self-improvement; he will feel himself in the one case listless and dissatisfied, in the other comfortable and happy: in the one case, if he do not appear to himself humbled, at least he will not have earned any claim to his own respect,—in the other case, he will enjoy a proud consciousness of having, by his own exertions, become a wiser and therefore a more exalted creature.

To pass our time in the study of the sciences, in learning what others have discovered, and in extending the bounds of human knowledge, has in all ages been reckoned the most dignified and happy of human occupations; the name of Philosopher, or Lover of Wisdom, is given to those who lead such a life. But it is by no means necessary that a man should do nothing else than study known truths, and explore new, in order to earn this high title. Some of the greatest philosophers in all ages have been engaged in the pursuits of active life; and an assiduous devotion of the bulk of

our time to the work which our condition requires, is an important duty, and indicates the possession of practical wisdom. This, however, does by no means hinder us from applying the rest of our time, besides what nature requires for meals and rest, to the study of science; and he who, in whatever station his lot may be cast, works his day's work and improves his mind in the evening, as well as he who, placed above such necessity, prefers the refined and elevating pleasures of knowledge to the low gratification of the senses, richly deserves the name of a true philosopher.

One of the most delightful treats which science affords us is the knowledge of the extraordinary powers with which the human mind is endowed. No man, until he has studied philosophy, can have a just idea of the great things for which Providence has fitted his understanding—the extraordinary disproportion which there is between his natural strength and the powers of his mind, and the force he derives from them. When we survey the marvellous truths of Astronomy, we are first of all lost in the feeling of immense space, and of the comparative insignificance of this globe and its inhabitants. But there soon arises a sense of gratification and of new wonder at perceiving how so insignificant a creature has been able to reach such a knowledge of the unbounded system of the universe—to penetrate, as it were, through all space, and become familiar with the laws of nature at distances so enormous as baffle our imagination—to be able to say, not merely that the Sun has 329,630 times the quantity of matter which our globe has, Jupiter $308\frac{9}{10}$, and Saturn $93\frac{1}{2}$ times; but that a pound of lead weighs at the Sun, 22 lbs. 15 ozs. 16 dwts. 8 grs. and $\frac{3}{4}$ of a grain! at Jupiter, 2 lbs. 1 oz. 19 dwts. 1 gr. $\frac{20}{43}$! and at Saturn, 1 lb. 3 ozs. 8 dwts. 20 grs. $\frac{1}{11}$ part of a grain! And what is far more wonderful, to discover the laws by which the whole of this vast system is held together and maintained through countless ages in perfect security and order. It is surely no mean reward of our labor to become acquainted with the prodigious genius of those who have almost exalted the nature of man above its destined sphere: when admitted to a fellowship with those loftier minds, we discover how it comes to pass that, by universal consent, they hold a station apart, rising over all the great teachers of mankind, and spoken of reverently, as if Newton and Laplace were not the names of mortal men.

The highest of all our gratifications in the contemplations of science remains: we are raised by them to an understanding of the infinite wisdom and goodness which the Creator has displayed in his works. Not a step can we take in any direction without perceiving the most extraordinary traces of design; and the skill every where conspicuous is calculated, in so vast a proportion of instances, to promote the happiness of living creatures, and especially of our own kind, that we can feel no hesitation in concluding that, if we knew the whole scheme of Providence, every part would be found in harmony with a plan of absoluto benevolence. Independently, however, of this most consoling influence, the delight is inexpressible of being able to follow, as it were, with our eyes, the marvellous works of the Great Architect of Nature—to trace the unbounded power and exquisite skill which are exhibited in the most minute, as well as the mightiest, parts of his system. The pleasure derived from this study is unceasing, and so various that it never tires the appetite. But it is unlike the low gratifications of sense in another respect: while those hurt the health, debase the understanding, and corrupt the feelings, this elevates and refines our nature, teaching us to look upon all earthly objects as insignificant and below our notice, except the pursuit of knowledge and the cultivation of virtue; and giving a dignity and importance to the enjoyment of life, which the frivolous and the grovelling cannot even comprehend.

Let us, then, conclude, that the pleasures of science go hand in hand with the solid benefits derived from it; that they tend, unlike other gratifications, not only to make our lives more agreeable, but better; and that a rational being is bound by every motive of interest and of duty, to direct his mind towards pursuits which are found to be the sure path of virtue as well as of happiness.

Holt's New Hotel.—We have given on our first page a correct engraving of this splendid edifice, which was completed during the last year; and as it is one of the most prominent buildings in this city, we have selected it as the first of a series of views in New York and its vicinity, which we purpose from time to time to present to our readers. Those who have only seen the outside, can form very little idea of the regularity and order which is observed in conducting the internal arrangements. The worthy host appears to have *a place for every thing, and every thing in its place*; it combines

all the advantages of a hotel and boarding house, and to the casual visiter of this city, as well as to those whose ordinary occupations require them to locate in it, or its vicinity, it affords every advantage that could be desired Every delicacy can be obtained by, and every atter tion is paid to, the wishes of the guest.

As we conceive a detailed description o the building may be interesting to our readers, we shall subjoin one we have been favored with from a source which, we are satisfied, cannot but be correct.

It stands on a base of 7 feet, with a foundation of 3 feet—the basement wall is 2 feet 6 inches, and all the main walls are 20 inches thick. The basement and first story are of Hallowell granite—the five stories above, and the tower, of marble; and in order to add to the security of the building, all the main joints of the marble and granite are clamped together, and then made fast to iron straps or bars, which extend, some twenty, others thirty feet, into the partition or division walls, with anchors at the end. The corners are also secured by anchors or bars of iron in each direction, twelve feet in length. For the above purposes alone, ten tons of iron were used.

Three of the sides front on three different streets, viz.: Water street, Fulton street, and Pearl street. In the engraving affixed is a view of the front in Water street, and a side view of that in Fulton street. Its breadth in Water street is 85 feet 6 inches—in Fulton street 100 feet—and in Pearl street 76 feet 6 inches; the principal entrances are in Water street. In the relish room there can be found superior accommodation, on terms as reasonable as at any establishment in this city.

A great portion of the basement is devoted to cooking rooms and other necessary purposes. In the yard, under a platform, is a steam engine of 12 horse power, which is daily used to bore for pure water—already it has penetrated upwards of 500 feet into the earth; it is applied also to turning of spits—to grinding and cleaning knives; it abridges labor by carrying up the dishes, when cooked, to each story—the baggage also is in this manner conveyed to their several places of destination. On the Pearl street and Fulton street sides are several stores, which are let out for various purposes of trade.

In the 2d story will be found a dining room 100 feet in length, fronting Fulton street; the Water street side is a large room, in which there is daily a Public Ordinary, and to which resort many of the most respectable and influential men of the city. There are also other rooms used as parlors, with the privilege of a private staircase and a spacious Hall.

In the 3d story are apartments judiciously constructed for the use of families, consisting of elegant and pleasant sitting rooms, and one, two or more bed rooms, as may be necessary, with every convenience that can be desired.

The 4th, 5th and 6th, are also divided into parlors and bed rooms to suit the convenience of smaller families, and of travellers who wish to have private apartments. Three hundred persons may be accommodated with lodgings; and one thousand can sit at the different tables, at the same time.

On the roof, enclosed by a substantial iron railing, is a spacious promenade, for the convenience of visiters, which will accommodate 500 persons; when the weather permits, it commands a beautiful prospect of the surrounding country, and of the shipping in the river, and much amusement is afforded by witnessing the bustle below of arrivals and departures of steamboats and other conveyances.

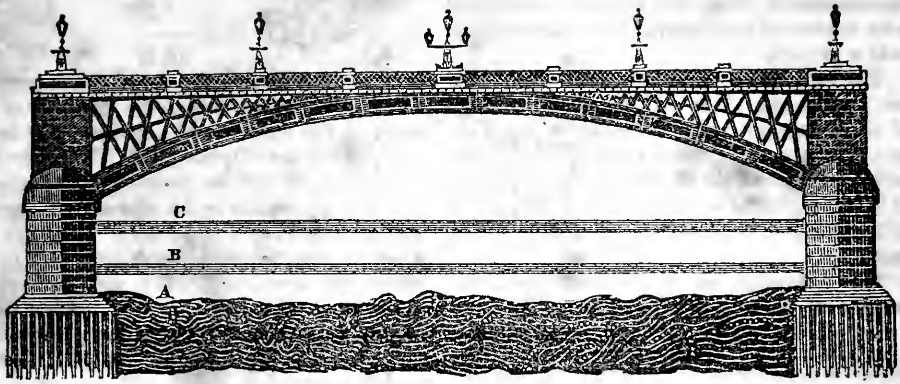
In the attic story there is a saloon provided with refreshments of all kinds for the accommodation of visiters to the promenade. There are also separate bathing rooms.

The dome is built immediately over the basement, and in it there is room for a full band of musicians.

The height of the building from the first floor is 135 feet; and for convenience of arrangement, or excellence of construction, it is undoubtedly equal to any other edifice in this country.

As this magnificent mansion has been reared by the persevering industry and economy of one individual, we think that a short account of his progress in life since his first arrival in this city cannot fail to be interesting, and it will afford an additional proof of what can be accomplished by such means, and more especially exhibit to our younger readers the value of pursuing through life an undeviating course of integrity and honor. It is by such a course only that they can arrive at that high distinction which Mr. Holt has arrived at, viz. to be *respected, and enjoy the good wishes of all* that have the pleasure of knowing him.

It was our intention to have accompanied the preceding with a brief memoir of the Mechanic and Gentleman, who, by quiet industry, has accomplished so much in a few years, notwithstanding he once, in the mean time, lost every thing he possessed, by fire, but want of room compels us to defer it until another time.



A, bed of the river ; B, low water mark ; C, high water mark.

[*From the London Mechanic's Magazine.*]

SOUTHWARK IRON BRIDGE. Architect, Rennie. 1814-20.

For several centuries the only direct means of communication from the Borough of Southwark to the city of London was by passing over London Bridge, the then only Bridge across the river Thames. Since the time of Stowe, however, (who mentions that bridge with particular satisfaction,) the rapid extension of the Borough had frequently suggested the great necessity of some more direct means of communication to the heart of the city. But it was to our own times that the ultimate execution of his design was reserved. The successful projector of the scheme was Mr. John Wyatt, proprietor of the Repertory of Arts. In 1807, that gentleman first turned his attention to the subject, and labored incessantly, and in spite of every obstacle, till the year 1811, when an Act of Parliament was obtained, authorizing the necessary sums to be raised, amounting in the gross to 400,000*l.* in transferable shares of 100*l.* each; and containing permission to raise (by way of mortgage or annuities) the sum of 100,000*l.* should such further sum be required to complete the works with its necessary approaches, and for securing the subscribers against extra calls over and above the amount originally stipulated for.

The Committee of the proposed Bridge consisted of the following gentlemen :—Sir J. Jackson, Bart. chairman ; John Allnut, Esq. Chas. Barclay, Esq. M. P. Samuel Davis, Esq. East India Director ; Robert Pott, Esq. Henry Perkins, Esq. Charles Price, Esq. George Ranking, Esq. John Ramsbottom, Esq. M. P. William Salte, Esq. William Slade, Esq. John Taylor, Esq. M. P. William Williams, Esq. Banker ; and Sir Joseph Yorke, Bart. M. P. Whether any other committee was formed prior to this I am unable to determine, but the before mentioned names agree with those given in the "Repertory," as also in the copy of a Prospectus now before me.

Mr. Wyatt, it appears, was at the time personally acquainted with the late John Rennie, Esq. who, at his (Mr. Wyatt's) recommendation, had professional conferences with the Committee of management, on the propriety of erecting the bridge, and the nature of its construction. Mr. Rennie was, of course, satisfied that a bridge was required, and the Committee being satisfied that the care of its execution could not well be placed in abler hands, gave the necessary directions for designs and drawings to be prepared for their inspection. Accordingly Mr. Rennie furnished two designs for the intended bridge ; one of stone, to consist of five arches, and one of iron, to consist of three arches, with granite piers. The latter design was preferred and carried into execution. (See above engraving of centre arch.)

The works, however, were not commenced until the year 1814—operations being stayed by parliament till such time as all the shares were disposed of. It must be admitted that this undertaking of Mr. Rennie's was bold and arduous in the extreme. Little is known at present as to the best mode of constructing bridges of iron. The great number of the parts, and the paucity of scantling compared with stone bridges, and the immense labor in fixing those parts, render it, in many respects, a distinct arrangement in bridge-building. Also, if we consider the enormous spans of the arches of Southwark Bridge, and the number of them (only three,) we cannot withhold our

commendation from the scientific individual who conceived and carried into execution so bold a project.

The invention of iron bridges is due to British mechanics. It is said that the first bridge of this description was invented by Mr. Thomas Paine, and intended for America as the subjoined list will show. The repeated failures of iron bridges show clearly that experience is still wanting to render them of sufficient permanency.

The following are the most remarkable bridges of iron not of the suspension kind:

	Dates.	Architects or Builders.
Southwark, London	1814,20	J. Rennie.
Colebrook Dale, over the Severn	1779	Darby.
Mr. Paine's bridge, intended for America, but not having money sufficient the arch was taken down by the builders, Messrs. Walker, of Rotherham; part of the materials were employed in building Sunderland and Wearmouth, in 1790.	1790	
Over the River Wear	1793.6	Walker, Wilson, Burden.
Buildwas, (Colebrok Dale Company)	1795.6	Telford.
Tame, Herefordshire—when centering was removed (failed)	1795.6	
Parret, at Bridgewater, Dale Company	1796	
Staines (failed twice)	1800	
Tees at Yarm (failed)		
Boston, in Lincolnshire, and two over the New River at Bristol.		

[*From the American Railroad Journal.*]

Mr. Editor—Should you consider the following formulas, relating to the effect of grade and curvature upon the motion of Railroad cars, to be of any value to the readers of your Journal, they are offered to you for insertion.

In estimating the effect of curvature, it is necessary to have a general formula for the value of the centrifugal force. Take V = the velocity of a car in miles per hour; R = the radius of curvature of the track in feet; w = the weight of the car in lbs.; and f = the centrifugal force in lbs. From known principles, the following expression for the value of f is obtained:

$$f = w \times \frac{V^2}{15\,R}$$

Now the effect of the force f is to produce a continued pressure upon the bearing of the axles of the wheels, and also upon the flange and edge of the exterior rail. Take therefore T to denote the friction caused by that pressure, and which amounts to the increase of traction arising from centrifugal force. Although the pressure may be nearly the same at both of the points just mentioned, yet it may perhaps be sufficient to take the amount of friction equal to $\frac{1}{4}$ of the whole centrifugal force,* in which case the following formula is at once derived from the preceding:

$$T = w \times \frac{V^2}{60\,R}$$

In making a selection, from diferent routes, for the location of a line of Railroad, it may sometimes be necessary to compare grades with curvatures. Thus the traction arising from grade alone is expressed by the quantity $w \times \frac{n}{\sqrt{1+n^2}}$, or simply by $w \times n$, very nearly; in which n represents the rise or fall in the distance unity: and therefore, when the traction arising from an ascending grade is equal to that arising from curvature, the following formula obtains: $n = \frac{V^2}{60\,R}$

From which either of the three quantities, n, V, or R, may be found when the other two are given; and thus it is easy to compute what grades and curvatures are equivalent to each other, as regards traction, with any given velocity.

In order to express a general formula for the traction when the road-way has both inclination and curvature, let $w \times m$ be the traction upon a straight horizontal way. The expression for the whole traction T will then evidently be as follows:

$$T = w \times \left\{ m \pm n + \frac{V^2}{60\,R} \right\}$$

This formula will be of use in all cases where it may be desirable to compare the traction,

* It may perhaps seem at first view, that the increase of traction is less than the friction here given, in the ratio of the radius of the wheel to the height of the flange. That, however, would be an error; but whether a different ratio than that of 1 to 4, as here adopted, will best comport with truth, can only be determined from experience.

under circumstances of various loads, grades, curvatures, and velocities.

It may, perhaps, be of some use to investigate a formula for determining the greatest velocity which will comport with safety, upon curves of given radii, and with wheels of given diameters. Let k denote the distance between the axles, and put $P =$ an arc to rad. 1, and length $\frac{k}{2R}$. The two following theorems will give the principles upon which the investigation is made.

1st. The force necessary to cause the flange of a wheel to ascend upon the rail is in a ratio compounded of the sub-duplicate ratio of the height of the flange, and the reciprocal sub-duplicate ratio of the radius of the wheel.

2d. When the force necessary to cause the flange to ascend upon the rail is to the friction of the flange upon the edge of the rail, as radius to Cos. P: then is the car equally liable either to run off the track, or to continue upon it.

The demonstration of these two theorems, which, for the sake of brevity, is omitted, may be easily supplied from received principles of mechanics.

Now, the friction of the flange is as $\frac{V^2}{R}$; and putting $r =$ the radius of the wheel, and $h =$ the height of the flange, the force necessary to raise the flange upon the rail, is as $\left\{\frac{h}{r}\right\}^{\frac{1}{2}}$. But it will, in most cases, be sufficient to take, radius to Cos. P. a radius of equality; in which case $\frac{V^2}{R}$ is as $\left\{\frac{h}{r}\right\}^{\frac{1}{2}}$; that is, V^2 is as $R \times \left\{\frac{h}{r}\right\}^{\frac{1}{2}}$; or, $V^2 = A \times R \times \left\{\frac{h}{r}\right\}^{\frac{1}{2}}$; in which A is some constant quantity to be ascertained from experience. With wheels five feet in diameter, and flanges $1\frac{1}{4}$ inches in height, and upon a track of 1,000 feet radius, the utmost safe velocity is, perhaps, about 20 miles per hour. Substituting these values in the above equation, the result will give $A = 2$, very nearly. The general formula will, therefore, be the following:

$$V = \left|2R \times \left\{\frac{h}{r}\right\}^{\frac{1}{2}}\right|^{\frac{1}{2}}$$

From which it will be easy to compute the greatest safe velocity upon any curve, and with wheels of any diameter. V. D. G.

Lexington and Ohio Railroad, Nov. 27, 1832.

Substitute for Printing.—A new process has been discovered and brought into use at Brussels, whereby French books and journals may be printed with great facility and perfect accuracy. It consists of an operation by which, in less than half an hour, the whole of the letter press upon a printed sheet may be transferred to a lithographic stone, leaving the paper a complete blank. By means of a liquid, the letters transferred to the stone are brought out in relief within the space of another hour, and then, with the usual application of the ordinary printing ink, 1500 or 2000 copies may be drawn off resembling minutely the original typography. The immense advantages of this discovery, for which M. Mecus Vandermacien has solicited a patent, may be easily conceived. A first application of this discovery has been made by him upon the "Gazette des Tribunaux," which is to appear at Brussels under a new title.

[Rep. Pat. Inv.

[*From the Journal of the Franklin Institute.*]

AMERICAN PATENTS.

For a Filtering Machine to be used in the Art of Manufacturing Paper; Thomas French, Ithica, Tompkins Co., New York, May 26.

This machine is to perform the task of what has been usually called a pulp dresser, some of which instruments we have formerly described. A cylindrical vessel of copper, or of brass, is to be made with slots, or openings from top to bottom, exhibiting the appearance of bars about one-fourth of an inch wide, and one thirty-second part of an inch asunder. It may be made solid, and afterwards cut in this manner, or it may be composed of metallic bars put together. It may also vary in its form, being either square, polygonal, or otherwise. Its diameter may be fifteen, and its height fourteen inches.

A perforated dasher is to be made to play up and down in this vessel by means of a crank, giving a velocity of from five to six hundred strokes in a minute. The pulp admitted into it is thus forced through between the bars into a vat below, whilst the knobs, &c., are retained, and are removed, when necessary, through a suitable opening. The rim of the dasher stands about half an inch from the sides of the cylinder, and its vibration approaches the bottom within half an inch, and the top within four or five inches. To supply the cylinder with stuff, a conductor of the requisite size passes through the top, or cover, of it.

The cylinder is enclosed within a close square

box of wood, and one which has been made of the given dimensions supplies a machine vat which works the pulp beat by two engines. The driving power is said to be equal to about that of a man. If the metallic vessel is made sufficiently strong, so that the bars will not yield to the pressure, the necessity of picking the paper after it is dried is said to be obviated altogether; whilst, from the agitated state in which the pulp is thrown into the vat, the fibres are more perfectly entangled than is general in machine paper, and it is thereby improved in quality.

For an Improvement in the Silk Reel; Charles G. Green, Windsor, Windsor county, Vermont, May 30.

The improvement here described is intended to distribute the silk upon the reel with perfect regularity, and thus to prevent the occurrence of the defect which is known by the name of glazing; and consequently to produce silk of a better quality than can be obtained by the common reel. To effect this purpose the reel is made to traverse backward and forward with perfect regularity; this is done by lengthening out the gudgeons of the shaft of the reel, so that they shall each form cylindrical rods of the full length of the reel itself. These turn in boxes upon the frame of the reel, having a crank upon one of them for that purpose.

These rods may be about an inch in diameter, and upon one of them two channels are cut from end to end, one of these forms a right, and the other a left handed screw. A guide piece in one of the boxes, acting alternately in these grooves, causes the reel to traverse backward and forward. This is the part which forms the subject of the patent, it being the only one in which this reel differs essentially from others.

As there are two cylindrical rods, we should suppose that it would be better to have the right hand screw on one of them, and the left hand screw in the other; as in the machine described, these grooves cut each other in their crossing, at every turn. The principle of action would remain the same, although in the case suggested each box must have its guide piece, which could be engaged and disengaged by very simple gearing.

For an Improvement in the Box and Hub of Wheel Carriages, and in the Method of Hanging Coach Bodies; David Watson, Fayette, Kennebeck Co., Maine, May 29.

Boxes are to be made of cast-iron, of the usual form on the exterior, but with a rebate at each end in the interior, so as to receive a copper ring, cast for the purpose, which is to be five-eighths of an inch deep, and three-fourths thick. These rings are driven in against a shoulder on each end of the cast-iron box, and are secured by riveting; they form the bearing for the axle, the bore of the cast-iron between them being such us to allow a space of three-eighths of an inch between it and the axle.

A hole is to be bored through the hub and the iron box at the middle of the axle, for the purpose of supplying oil. A sponge is to be placed in this hole to retain the oil and lubricate the axle, and it is closed by means of a screw, to prevent the entrance of dirt and water.

In hanging carriage bodies, the first improvement described is the putting of steel rollers three inches long, and an inch and a quarter in diameter, at the upper ends of the jacks, over which the thorough braces pass. Under the body of the carriage, and extending from one end of it to the other, over, and in the direction of, the perch, an elastic beam or strip of wood passes, which is three inches wide, and an inch thick, and this is connected on its under side to levers, by strong spiral springs, which are arranged in a way which could not be clearly explained without the drawings, but which are intended to give the most perfect elasticity to the whole structure, and are, it is averred, capable of being so managed as to cause the passenger to ride with equal ease, whether a stage be loaded lightly or heavily.

The claim is to the copper rimmed boxes, and the mode of applying them; the adaptation of the iron boxes to them; the mode of supplying the oil; and the described manner of hanging the bodies of stages, or other carriages.

Notes of an Observer on an Opinion respecting the Draft in Chimneys; and on another relating to Inertia, which appeared in this Journal. [From the Journal of the Franklin Institute.

In vol. iii. p. 352, of the Journal of the Franklin Institute, there are some very judicious answers given to some queries on the subject of draft in chimneys. I think, however, the author is wrong in his answer to the 5th question. "Will a chimney largest at the top, or vice versa, make the strongest draft?"

Ans. "As that portion of the column of heated air, &c., nearest the burning coals must necessarily be more expanded, and require more room, than at the top of the chimney, where their temperature and volume are diminished, a chimney largest at the bottom must be better calculated to promote a rapid current through it, than the same chimney with its apex reversed." The reason here given is extremely plausible, but I would not rely on it, without experiment, for the following reasons: First, if the upper part of the chimney is enlarged, the friction will be diminished by the diminished velocity. Second, it is highly probable that elastic fluids flowing through tubes have their flow increased by expanding tubes—on the principle of Venturi's adjutages. Because, from the very nature of inertia, whatever velocity may be generated in the lower part, if contracted, it inclines to preserve the same in the wider part above, and thus to increase the draft.

However this may be, I have one remark to make which will be useful to those whose houses smoke in windy weather, or whose furnaces draw worse in windy weather than in calm.

Let a roof, or inclined plane, be made of tin or sheet iron, or boards, from the top of the chimney walls, outwards and downwards, at an angle of 45 degrees with the perpendicular walls; extending two or three feet from the top each way, more or less, according to the size of the chimney. With such an arrangement at the top of a chimney, the draft will be greatly increased by a strong wind. The experiment has been tried at the suggestion of the writer of this paragraph with complete success. The modus operandi is obvious. The more violently the wind blows, the more will the weight of the column of air over the chimney be lifted up by the oblique direction given to it by its striking against the plane; that is, a partial vacuum will be created exactly over the top of the chimney.

It is known that a draft in a chimney may be increased by letting into it highly condensed steam, through a pipe opening upwards: and I have been told by practical engineers, that a greater effect is produced by letting the pipe open low down in the chimney, than near the top.

The reason appears to me to be that the velocity given to the gas in the chimney near the bottom is nearly preserved throughout its whole extent by the nature of inertia.

It might be curious to inquire, what is the velocity with which air moves upwards in a chimney of a given height, with a given temperature above the air on the outside. Now, it is known that if the atmosphere were of a uniform density, equal to that at the surface of the earth, it would be twenty-seven thousand feet high. If a body were to fall freely in vacuo from this height to the earth, it would acquire a velocity of thirteen hundred and thirty feet per second, and this is the velocity with which air would rush, by its own pressure, into a vacuum.

It is also known that the velocity with which fluids are discharged under different pressures, is as the square roots of those pressures, that is, four times the pressure will give double the velocity, and nine times the pressure three times the velocity, &c. If there is pressure both ways, as in the case of one fluid rushing into another, with different heads of pressure, then the velocity will be proportional to the square roots of the differences of pressure. For example, suppose two vessels filled with water, one twenty-seven thousand feet high, and the other sixteen feet higher, and a communication made between these two vessels, either near the top or bottom, the fluid would be discharged with a velocity due to a head of sixteen feet. For the writer of this article demonstrated by experiment that water makes no resistance to water issuing under a given head. The same law will apply to the gases; consequently the resistance at the top of the chimney to the issuing air is nothing. If, now, we ascertain how much less air there is in a chimney in consequence of its rarefaction by heat, we shall be able to calculate the velocity with which the external air moves upwards into it, by the following very simple rule: Multiply the square root of the number of feet which the chimney contains in perpendicular height, less than a column of air of the same height on the outside, by eight, and the product will be the velocity in feet per second with which the air will move into the chimney. Now it is known that air, at the temperature of 32° of Fahrenheit, has its bulk doubled by an increase of four hundred and eighty degrees of temperature. Suppose, for example, that a chimney is thirty-two feet high, and the temperature of the air on the outside is thirty-two degrees, and the temperature of the air in the chimney, at a mean, four hundred and eighty above thirty-two, then will the quantity of air in the inside of the chimney be only one-half of what it is in a column on the outside of similar height. The difference of head, then, will be sixteen feet. The square root of sixteen is four, and this square root multiplied by eight,

the product is thirty-two, which is the velocity with which the air moves per second into the chimney.

Again, suppose the chimney is eight feet high, and the temperature as before. Then will the quantity of air on the outside be four perpendicular feet more than that in the chimney. The square root of four is two, and two multiplied by eight is sixteen, which is the velocity of the air passing into the chimney. Again, suppose the chimney to be two feet high, and the temperature as before, then will the difference of head be one foot, and the square root of one is one, and one multiplied by eight is eight—the velocity per second, in feet, with which the external air moves upwards into the chimney.

As the temperature of the air on the outside of the chimney is not always thirty-two, it is desirable to know what the volume of such air would be at thirty-two.

It may be obtained by the following rule: First, for temperature above thirty-two: Add the number of degrees of Fahrenheit above thirty-two, to four hundred and eighty, and divide four hundred and eighty times the volume of air on the outside of the chimney by the sum, and the quotient will be the volume of air, at the temperature of thirty-two. Again, for temperatures below thirty-two: Subtract the number of degrees of Fahrenheit below thirty-two from four hundred and eighty, and divide four hundred and eighty times the volume of air on the outside of the chimney by the remainder, and the quotient will be the volume of air at the temperature of thirty-two.

As we have now before us data for calculating the velocity with which air rushes into a chimney at any temperature without and within, we will illustrate the rules by one more example. Let the chimney be 32 feet high, and the temperature on the outside be 60 degrees above, and in the inside 480 degreee above 32. Now, let the 480 times 32 be divided by 480 added to 60, and the quotient will be $28\frac{4}{10}$ feet, the column of air on the outside at the temperature of 32. Again, let 480 times 32 be divided by 480 added to 480, and the quotient will be 16 feet, the column of air in the inside of the chimney at the temperature of 32; therefore, the difference of the heads of pressure in this case is 16 subtracted from 28.4, which is 12.4.

If, now, according to the rule given above, the square root of 12.4 be multiplied by 8, the product will be $28\frac{17}{100}$ feet, the velocity with which air at a density due to the temperature of 32 will flow into a chimney at the above temperatures.

In these calculations no allowance is made for friction along the side of the chimney, and in passing through the fuel at the entrance. Neither has any notice been taken of the fact that the gases which pass up the chimney, after having performed the office of combustion, are always of greater weight than the air which enters.

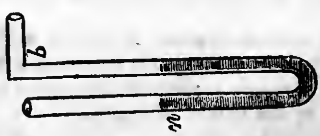
Even when pure dry carbon is the fuel, if all the oxygen of the air which enters unites with it, the gas which ascends in the chimney is seven and a half per cent., heavier than the air which performs the combustion; and this alone will always diminish the velocity of the entering air more than seven and a half per cent., for that much more matter has been put in motion with a velocity greater than that of the entering air.

If wet materials are used for combustion, the diminution of velocity will be much greater.

It will be seen from the above examples that a chimney thirty-two feet high gives a velocity only double that of one which is one-fourth as high, and only four times greater than that of one which is one-sixteenth as high. And in general, the velocity of air moving up chimneys of different heights, with the same mean temperatures, neglecting friction, is as the square roots of their heights.

These calculations are all made on the supposition that the chimney is of the same diameter throughout. The writer believes the draft would be increased below if the chimney should be widened out a little above the fire; but the exact form, best suited to produce the greatest effect, must be ascertained by experiment. This much may be said, that if the object should be to burn as much coal as possible in a chimney of a given height and diameter, so as to produce the most intense heat possible by a natural draft, the chimney should be of a shape somewhat like Venturi's adjutage, with the fire in the "contracted vein."

If the principles explained above are clearly comprehended, it will be extremely easy to understand another method of ascertaining the velocity with which air rushes up a chimney at any moment, which I now proceed to explain.



Let a tube of glass, of any convenient diameter, of equal bore throughout, be bent as in the adjoining figure, so that its two legs may be parallel, and one of them near the top be bent at right angles, as at *b*. If, now, these two legs be filled to a certain height, *n*, with water, care being taken to keep the legs vertical, and the end *b*, thrust into the chimney just above the fire place, the water will rise in the leg *b*, and sink in the other. Now, as water is 800 times heavier than air, if the difference of the heights of the water in the two legs be multiplied by 800, it will give the head of pressure of air on the outside of the chimney above that within.

If this be reduced to feet, and the square root of the feet be multiplied by eight, it will give the velocity of the air rushing into the chimney as before. Suppose the difference of the height of the water in the two legs is four-tenths of an inch; 800 times four-tenths of an inch is 26.66 feet, and the square root of this multiplied by 8 is 41 feet, which is the velocity with which air rushes into the chimney where the leg of this anemometer is inserted.

As the method by the anemometer gives the actual velocity, free from the uncertainty of friction in the chimney, it will be superior to the former, if no uncertainty should arise from the difficulty of measuring the depression of water in the tube.

I am aware that these calculations are founded principally on theoretical principles, and that they give a velocity about one-sixth greater than Dr. Hutton's experiments on the impulse of air in motion, which appears to me to be the converse of the principles calculated above; yet as experiments differ very widely among themselves, so as to leave great doubt on the subject, and as my calculations are founded on acknowledged principles, I do not hesitate to present them to the readers of the Journal of the Franklin Institute.

In vol. iv. p. 35, there is an essay by Thomas W. Bakewell, Esq. a gentleman who discovers much acuteness of mind on various subjects discussed by him in this journal, which, for that very reason, is the more deserving of notice, since the weight of his authority, if uncontradicted, might with many be considered sufficient to subvert a doctrine which has been universally admitted among philosophers as resting on the immoveable basis of demonstration.

The chief object of the essay under consideration is to show that inertia varies with gravitation. The author says, "If a hundred pound ball were taken to such a distance from the earth as should lessen the attracting force, or weight, to one pound, it would have lost 99 per cent. of its weight or attracting quality, and also 99 per cent. of its impeding quality, inertia, and would therefore be in exactly the same situation as a ball weighing one pound is when sixteen feet from the earth, and would consequently fall from this point in one second of time."

Now this is mere hypothesis, and is besides contrary to known facts. For instance, if the author will put himself to the trouble to calculate how far the moon deviates from a tangent to her orbit in one second of time, he will find that instead of falling below it sixteen feet as his doctrine requires, she falls only $\frac{1}{3600}$ of sixteen feet, the exact distance she should fall on supposition that her inertia is undiminished by her removal from the earth's centre sixty times as far as a body at the surface of the earth, where it is known by experiment she would deviate from a tangent sixteen feet in a second of time, provided she weighs only one hundred pounds. For if the received law of gravitation is correct, and Mr. Bakewell seems to admit it, then the gravitation of the moon to the earth, is only $\frac{1}{3600}$ of what it would be if she was at the earth's surface; that is, sixty times as near the centre of attraction—for sixty times sixty is thirty-six hundred.

If Mr. Bakewell is not satisfied with this single fact, which appears to me decisive, let him calculate how far the several planets fall below a tangent to their orbits in a second of time, and he will find they fall exactly as far as they should do, on supposition that their inertia is neither increased nor diminished by gravitation. The method of making the calculation, a demonstration of which is given in mechanics, is the following—Multiply the number of feet which a planet moves in its orbit in one second of time, by itself, and divide the product by the diameter, in feet, and the quotient will be the number of feet which the planet deviates from a tangent in a second. It will be found, by calculating according to this rule, that the deviations from the tangents of the orbits of all the planets are inversely as the square of their distances from the sun. Now if Mr. Bakewell's doctrine is true that inertia is always in proportion to gravitation, these deviations from the tangants should be equal in all the planets in equal times. For he says, "if we suppose the attraction of the earth

should be increased a hundred fold, the velocity of a ball, falling sixteen feet, would not be increased or changed, because the inertia, or impeding power, would also be increased at the same rate, and therefore under every degree of gravitating force, or whatever may be the quantities of matter contained in the bodies acted upon by it, the velocity with which they obey it is as the rule for falling bodies near the earth, sixteen feet the first second," &c.

Again he says, "if the earth were divested of the motion in its orbit round the sun, and, consequently, of its centrifugal force, it would fall to that body under the same law, and commence its career at the same rate, that an apple falls from a tree, viz. sixteen feet the first second," &c. For the sake of testing the correctness of this opinion, as well as illustrating the rule given above, let us actually calculate how far the earth deviates from a tangent to its orbit in one second of time; for this is the exact distance it would fall towards the sun in one second, if its projectile force were destroyed. Suppose its distance to be ninety-six millions of miles, its orbit then will be 3.1416 times twice 96,000,000=603187200 miles nearly. This multiplied by 5280, the number of feet in a mile, gives 3184828416000, the number of feet in the earth's orbit. This number again being divided by 31557600, the number of seconds in a year, gives 100921 feet, nearly, for the distance the earth moves in her orbit, in one second of time. The square of this last number, that is, the number multiplied by itself, is 10185148241, and this divided by 1013760000000, the number of feet in the diameter of the earth's orbit, gives .01004 feet, the distance which the earth would fall towards the sun in one second, if her projectile motion were destroyed. That is, she would fall but little more than one-ninth of an inch, instead of sixteen feet.

By calculating in a similar manner the distance which Herschell falls from the tangent of his orbit in a second, by the force of the sun's attraction, it will be found to be nearly 361 times less than that of the earth, for Herschell is nearly nineteen times further from the sun than the earth, and 19 times 19 is 361.

Mr. Bakewell says, "a friend of mine thinks that the tides make against my theory; for if the waters on the earth are at all influenced by the moon's attraction, they ought to fall to it at once."

I agree with this friend, and I think if Mr. Bakewell examines again what he has written in answer to this objection, he will find he has said nothing to show the possibility of there being a tide on the opposite side of the earth from the moon.

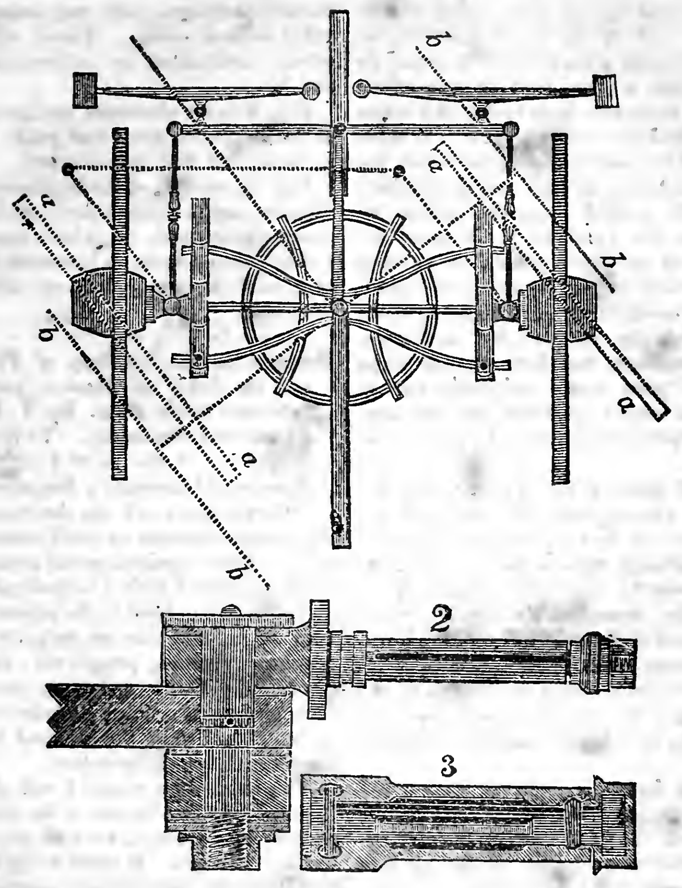
Indeed, some of the consequences of Mr. Bakewell's hypothesis are so evidently absurd, that I cannot imagine how it could have been entertained for a moment by a gentleman who, in some of his subsequent essays, manifested a very acute mind.

For example: If there were only two bodies in the universe, one indefinitely large, the other indefinitely small; for instance, the sun and a grain of sand; by this hypothesis they would fall towards each other with equal velocities, and would move the same distance the first second, when placed one thousand millions of miles apart, as if they were separated only one hundred yards.

According to Kepler's law, which is not hypothetical, but derived from patient observation, the squares of the periodic times of all the planets round the sun are as the cubes of their distances: according to Mr. Bakewell's hypothesis, the periodic times would be as the square roots of the distances. Again, from Kepler's law it is known that the velocities of the planets in their orbits are inversely as the square roots of their distances: whereas, by Mr. Bakewell's hypothesis the velocities would be directly as the square roots of their distances. Let us take one example. Suppose a planet four times as far from the sun as the earth, and suppose, according to the hypothesis, it falls from a tangent to its orbit, the same distance as the earth falls, it may be shown by geometry that it must move twice as far in its orbit to be the same distance from the tangent as the earth is, in the same time, which moves in a circle four times less.

In like manner it may be shown that if a planet is nine times as far from the sun as the earth is, it will have to move three times as far in its orbit, to be removed the same distance from the tangent, at the end of a second, as the earth is. Now, according to the law which actually exists in nature, the earth moves three times as fast as a planet which is nine times as far from the sun as itself: whereas, according to the hypothetical law we are examining, the planet would move three times as fast as the earth.

If this article should be successful in freeing an active and ingenious mind from the trammels of a false hypothesis, on a subject of high importance, it will not have been written in vain.



Mason's Patent Improvements in Locking the Fore Wheels of Four-Wheeled Carriages. Communicated by the Inventor, for the London Mechanics' Magazine.

It has long been acknowledged, that the present mode of locking the fore wheels of four-wheeled carriages from the centre is very unsafe, and many times the cause of serious accidents. This arises from both the fore wheels being fixed or mounted to the same axletree; the consequence is, that when wheels so attached are locked, the fore wheels form little more than three bearings or points of support, from which circumstance four-wheel carriages are very liable to be overturned. Another great inconvenience is produced by the fore wheels so attached to the axletree being of necessity made much smaller than the hinder ones, causing thereby a very great increase in the draught; and if such wheels are increased in diameter, it can only be by allowing the body of the carriage to be placed much higher, which makes it both unsafe for use and inelegant in appearance.

In W. Mason's patent improvements on four-wheel carriages, the fore wheels may be made very nearly or quite as large as the hinder ones, thereby reducing the draught in a very considerable degree, and giving greater ease to those who travel in such vehicles, for it must be evident, that the smaller the wheels are, the more likely they are to fall into the inequalities found in the surfaces of roads, and thereby to cause jolting and very unpleasant motion; but in the improved mode herein submitted, these inconveniences are avoided, and the body of the carriage is also hung much lower, and in consequence it is more convenient to enter in and get out of; the appearance in point of elegance, is also much improved.

The principal advantages arising from the improvements herein submitted, are—

Firstly, instead of both fore wheels being mounted upon one axletree as usual, each

wheel is mounted on an arm, which arm is joined to the end of the fixed axletree, by which means each wheel locks so near its own centre, that a three feet six inch wheel will only run back one inch and a half when locked to the utmost extent required. Wheels thus mounted can never be placed under the body of the carriage, as they are in the usual manner, when locked from the centre, by which means the carriage is, in many instances, placed on three points of bearing only, from which cause so many accidents occur by the overturning of carriages, when the fore wheels are locked; but in the improved construction, the fore wheels when locked never pass under the body, but always, and in every position, present four points of support, even when locked to the utmost extent.

The dotted lines *a*, fig. 1, represent the axletree and wheels, with the new and improved method of locking them. The old method, of turning upon a pin or bolt in its centre, is shown by other dotted lines, *b*.

Secondly, by fixing the axletree in the centre, between the spring-bed and the horn-bar, the distance between the wheels is reduced, without diminishing the length of the upper carriage; by which arrangement the body will hang in a better and more elegant position.

Thirdly, by increasing the height of the fore wheels, and making them very nearly the diameter of the hinder ones, the unpleasant jolting that is produced by the present small fore wheels will be avoided: it being a well established fact that the larger any carriage wheel can be made, the less will it be liable to fall into the inequalities of the roads over which it passes, and from which cause so much unpleasant motion is produced. To this advantage may be likewise added the great reduction in the draught; which, with wheels so nearly equal in diameter, will be little more than half what it is in the old construction, while the beauty of a carriage constructed in this improved manner will be greatly increased; small fore wheels at all times producing a vacant appearance when viewed externally.

Fourthly, by fixing the swinging bars on joints, the draught of the horses is equalized in any position; and in turning, each is always kept tight.

Fifthly, these improvements can be applied to any four-wheel carriage without altering the hind part.

New contrivances for oiling the wheels and joints are also introduced, by which means carriages will run many thousand miles without oiling. These will be sufficiently understood by references to figs. 2 and 3.

Fig. 2 is an elevation and section of one of the improved arms and joints by which it is connected with the axletree.

Fig. 3, section of the improved box. Both the arm and the joints have cavities in their centres to contain oil, which passes through a side hole in each, to lubricate the box, the arm, and the joint, and one oiling will last for years. W. M.

Remarks on the Economy of Peat as Fuel, and the Ashes as Manure, particularly in reference to the Poor. By T. Bridgeman, Florist and Seedsman. To the Editor and Proprietor of the New-York Farmer and American Gardener's Magazine:

Gentlemen,—I am constrained to offer my congratulations to the Farmers and Gardeners of our country, on the prospect of their being furnished with a periodical publication calculated to exhibit to the attentive reader a fund of information on subjects which are constantly gaining proselytes; and from the circumstance of your having introduced into your specimen number, articles on a variety of subjects, I shall be induced to become a more regular correspondent.

The subject on which I am about to treat appears to me to be one of the utmost importance to the Farmer, as well as to the community at large. It must be acknowledged, that although this country contains an abundance of wood, coal, and peat, as well as almost every other description of fuel, that the poor of our large cities, in general, suffer greatly from cold; and if all the tales of woe could be sounded in the ears of a sympathizing community during our severe winter, I am persuaded it would arouse them to the consideration of a remedy. It is an acknowledged fact, that the poor of Europe are cheaper and better supplied with fuel than those of this country. This arises in a great measure from the circumstance of ashes being held in high estimation by Agriculturists; they are consequently a saleable article in their large towns and cities, at a price equal in some instances to half the cost of a winter's fuel.

In the third edition of a book I published last Spring, entitled "The Young Gardener s Assistant," I endeavored to stimulate the public to a consideration of this subject; and being convinced of its importance, I beg leave to introduce the following paragraph

from page 178 of that work, as being calculated to exhibit the subject in its most important bearings.

"Although our limits will not allow of a further description of the various sorts of insects which injure our gardens, and frequently destroy the first fruits of our labor, I cannot forbear directing the attention of our citizens to the importance of saving all kinds of ashes. If all agriculturists and horticulturists were to offer an inducement to the inhabitants of large cities to save their ashes, *in a dry state*, they would be supplied not only with a valuable manure, but an antidote for many kinds of insects; and our citizens would be at less risk from fire, by having a brick vault on the premises for safe keeping them. In England, a private dwelling is not considered complete without an ash vault, and a good farmer would dispense with his barn, rather than be destitute of an ash-house. I have known farmers supply the cottagers with as much peat as they could burn, on condition of their saving them the ashes; and there are some that will keep men under pay throughout the year, burning peat for the same purpose; and any thing that has passed the fire is so valuable, that a chimney-sweep will frequently clean chimneys for the sake of the soot, which is conveyed miles into the country, and sold at a price sufficient to reward the collector, besides paying all expenses; even the housekeeper's ashes in cities is a marketable article at all times, at from ten to twenty-five cents per bushel, *when kept dry and clean*, and a guinea a load (equal to $5) was formerly the common price in the villages of Berkshire and Hampshire."

Now I would ask, how it is that ashes are not as valuable to the farmers here, as they are in Europe? The extreme heat of the summers must certainly engender insects in equal if not greater proportions; and as respects manure, it must be scarcer in some parts of this extensive country, than it is in the dense populated countries of Europe. Perhaps some may answer that ashes are already used by our cultivators to a considerable extent; but I would remind such, that from the circumstance of their being mixed up with other manures, and exposed to all sorts of weather, (as in our city,) they lose their virtue, so that a load may not be worth more than a bushel would be, *if kept dry and clean*. The farmers of Europe consider peat ashes of more value than any others, and I am persuaded that could they be fairly tested by some of our best cultivators, great good may result to the community. If the farmers of England can afford to keep men under pay, perpetually burning peat for the sake of the ashes, it is natural to suppose that the poor of our community may be placed in easier circumstances as respects the article of fuel. Thousands of acres of land are to be found in the States of New-York and New-Jersey, and within a few miles of this city, which abound with peat earth; and the owners of such have already began to explore their treasures of this description. Good peat is now to be had in the city at the low price of eight cents per bushel, or three dollars per chaldron. It burns well in all sorts of stoves, and grates, whether made for wood or coal, and also on the hearth; and if the ashes are not used to any better purpose than other ashes have hitherto been, it is the cheapest fuel known. I am persuaded that this subject is worthy of serious consideration, and if the editors of the different papers would arouse the public attention so as to enlist some of our most active citizens to a consideration of the subject, incalculable good may result to the community at large.

If the honorable the Corporation of our city, and others who distribute fuel amongst the poor, gratis, would give them peat instead of wood, it would be much cheaper, and would answer every purpose to the consumers. In such cases twelve bushels may be given in the first winter month to each of the applicants, instead of wood, with a strict injunction that they save the ashes in a dry state, in order to their being taken in exchange for a future supply of peat. It could easily be ascertained how much ashes twelve bushels of peat would make, and if a strict attention be paid to the conditions of exchange, it would soon be discovered which of the applicants was most entitled to the distributor's bounty. The same sheds which it would be necessary to provide for housing the peat, could be used as a deposit for the ashes. If such sheds be conveniently constructed to hold each a moderate quantity, the first which is emptied of peat may be filled with the first ashes that are returned in exchange for a future supply of fuel, and they could be all used for the same purpose as they became empty. These ashes, when fairly tested, may become a merchantable article, as in Europe; and it is very probable that farmers may be induced to take them in exchange for future supplies of peat; they could, however, be conveyed into the country at a trifling expense, and would no doubt meet a ready sale.

I am persuaded, Mr. Editor, if you should succeed in arousing the public to a consideration of this important subject, that your periodical will be viewed as a public blessing; which, like railroads and canals, open channels calculated to extend our intercourse, and thereby promote the general interest and happiness of the inhabitants of this highly favored country. T. B.

Bowery Road, December, 1832.

The Lace Bark Tree (Lagetta lintearia) grows in the high rocky hills of Jamaica, to the height of twenty feet; the bark is thick, and may be separated into twenty or thirty laminæ, white and fine like gauze; of this caps, ruffles, and even whole ladies' suits of clothes, have been made.

Coal Trade of Pennsylvania. [From the Miner's Journal.]

We have laid before the public some statistical information respecting certain branches of the coal trade, including a view of the capital invested and labor employed in the business of mining and transporting to market the amount of the annual exportations of this mineral from this region. We have not entered into any calculation relative to the cost or value of the very expensive improvements incident to mining establishments. Neither have we said any thing concerning the lands themselves, whence our supplies are derived. The whole number of miners, laborers, horses, cars and boats, employed, together with the respective wages of the two first, and original cost of the latter, is comprehended in our statement, without any reference to other collateral subjects which might be introduced. The amount of coal exported from this region during the season which is just ended, is equal to two hundred and four thousand tons. If sufficient encouragement by early purchases is afforded to the industry of the miner and laborer, this quantity may be indefinitely increased, in a ratio at least equal to any future demands. No one in any degree acquainted with the extensive resources of this region will for a moment question the truth of this proposition. The natural capacity of our mountains to supply the article is literally boundless—the means of exportation adequate—the industry of our population greater than any requisitions that can be made upon it. An example afforded by a single locality will illustrate our meaning. On the West Branch railroad there are 325 cars, belonging to thirty colliers. Contracts have been already made for supplying one hundred additional cars. Without including other cars than those which are already on hand or positively engaged, we will commence our calculation by stating that each car will carry two and a half tons of coal. Allowing only one trip per day, while many very frequently make two, the sum total would equal one thousand tons per day, or six thousand tons per week. Estimating a period of thirty weeks for active operations during the season, the aggregate quantity would amount to one hundred and eighty thousand tons, almost thrice as much as is required for the annual supply of New-York. This is a very moderate statement of what can actually be accomplished by one-third of the coal region. Should the backwardness of purchasers and contractors suffer a considerable portion of the season for active operations to elapse without making provision, our calculation may not be verified—but the fault will not be ours.

Of the abovementioned 204,000 tons of the coal shipped from this region, there passed down the West Branch railroad

	67,059
Mount Carbon, - -	57,234
Schuylkill Valley, - -	27,981*
Mill Creek, about - -	30,300
Total, - - - - -	182,574

The balance of the 204,000 tons was mined on the line of the canal in this vicinity.

One miner can mine $1\frac{1}{2}$ tons of coal per day—say that he works 5 days in the week, and 45 weeks in the year, this will make 225 days; to mine 204,000 tons of coal will require in round numbers 600 miners. It will require as many persons to haul out, screen, and convey the coal to the landings, making openings, &c. as it does to mine the coal—therefore say 600 laborers.

The West Branch railroad is about 12 miles long—the average distance of hauling

thereon about - - -	9	miles
Mount Carbon railroad, 4 miles, do.	3	do.
Mill Creek railroad, 4 miles, do.	3	do.
SchuylkillValley do. 10 miles, do.	5	do.
	—20	

Average distance, say, 5 miles—one horse hauls 4 waggons, and makes two trips per day—each waggon averaging $1\frac{3}{4}$ tons—will make 14 tons for each horse per day—multiplied by 225 days, gives 3150 tons to each horse—which, divided into 204,000, gives 65 horses. It requires an equal number of

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*There also passed down this road 33,470 shingles, and 628,092 feet of boards.

horses to haul the coal out of the drifts—say 130 horses.

To carry this coal to market it requires about 400 boats—400 horses—and two men and one boy to each boat—making 1200 men and boys on the line of the canal. Total, 2400 persons and 530 horses actually engaged in mining the above coal and conveying it to market.

There are on the West Branch railroad in use 325 cars, Mount Carbon 150, Mill Creek about 200, Schuylkill Valley 230—total, 905 cars.

The cars on the West Branch and Mount Carbon railroads cost on an average $90 a-piece—and those on the Mill Creek and Schuylkill Valley cost about $50 a-piece—

which would amount to - -	$64,550
400 boats at $500 each -	200,000
530 horses at $40 each -	21,200
600 miners at $7 each per week	189,000
600 laborers at $6 do. do.	162,000
1200 boatmen at $5 do. for 32 do.	192,000
Active capital,	$828,750

RECAPITULATION.

Miners - - - -	600
Laborers and boatmen - -	1800
Total,	2400
Horses - - - -	530
Cars - - - -	905
Boats - - - -	400
Active capital - - -	$828,750

Price of Fuel in New-York, Dec. 18, 1832.

COAL.

	Cargo.	Retail.
Liverpool, per chaldron, - -	$11 50	$13 50
Sydney, do. - - - -	9 50	10 50
Nirginia, do. - - - -	9 00	10 00
Schuylkill, per ton, - - - -	9 50	11 00
Lehigh, do. - - - -	9 50	11 00
Lackawanna, do. - - - -	9 50	10 00

WOOD.

Hickory, per load, (¼ cord) - -	$2 50 *a*	3 00
Oak, do. - - - - -	2 00 *a*	2 25
Ash, do - - - - -	2 00 *a*	2 25
Pine, do. - - - - -	1 50 *a*	2 00
Chesnut, do. - - - - -	1 37 *a*	1 50

The following is the quantity of coal sent to market in the years 1831 and 1832, as near as can be ascertained, in round numbers:

	1831.	1832.
Schuylkill, - - - - -	81,000 tons	204,000
Little Schuylkill, - - - -		14 000
Lehigh, - - - - -	43,000	76,000
Lackawanna, - - - - -	53,000	85,000
	177,000	379,000
The consumption last year, as near as can be ascertained, was		227,000
		152,000

Showing an increase over the consumption of last year of 152,000 tons, and over the supply of the same year of 202,000 tons.

Advantages and Durability of Wrought Iron Ploughs. By B. To the Editor of the New-York Farmer, and American Gardener's Magazine.

Sir—Loudon tells us, in his Magazine for October, that these ploughs have in Scotland almost every where been substituted for wooden ones; and the saving is considered great, on account of their extreme durability. They have been introduced twenty-six years, and there is not an instance of one of them being worn out. I have had one in use two years, and think I studied economy, although I paid for it $28.

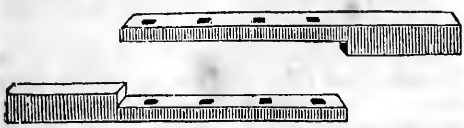
The draft is about the same as that of an ordinary wooden plough, and its work equal to the best, particularly on a sod. It has an almost indispensable appendage, too seldom seen to wooden ploughs—what is technically termed a *bridle*, by which the depth and width of the furrow slice is graduated at pleasure. Every farmer appreciates the importance of a plough running flat, or, in other words, of pitching neither upon the point or heel, when at work; yet few are aware, that a knowledge of a simple principle of mechanics will enable them readily to adjust it, in this respect, principally by means of a well constructed bridle. The *line of traction* is that which passes from the *point of draft*, or that point of the yoke or collar to which the chain and traces are affixed, when the cattle are exerting their power, to the *point of resistance*, that is, the point of the stock or share. This should be a straight line, *passing through the bridle*. If the bridle, to which the chain or whiffle-tree is attached, is above this line, the end of the beam is necessarily depressed, and the plough runs upon the point or sock; and if it is below, the same tendency is exerted to throw the plough upon the heel. But as I sat down merely to recommend iron ploughs, and not to lecture upon agricultural mechanism, I will only add, Mr. Editor, that you may find, upon this latter subject, much to interest your readers in Williamson's treatise on agricultural machinery and implements.

Expeditious Mode of making Posts for Fences. By [?] To the Editor of the New York Farmer, and Gardener's Magazine.

Sir—If an economical and expeditious mode of making posts for fences would be a desideratum to any of your readers, the annexed sketch and explanation are at your service.

It almost explains itself. After you have hewn your post *entire*, which must obviously

be from eighteen inches to two feet longer than is required for a single one, saw it half



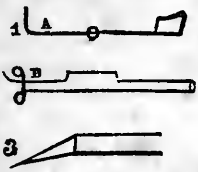
through, at equal distances from each end, but on opposite sides; then split it down the middle, and you have two good posts with a little more than the trouble of one. For post and rail fences, mortice it first, and proceed in the same way.

[From the Journal of the Franklin Institute.]

Specification of a patent for a mode of detaching horses from a carriage, either when running away, or whenever it may be desirable to effect that object rapidly. Granted to ROBERT BEALE, *City of Washington, District of Columbia, May* 12, 1832.

Be it known, that I, Robert Beale, of the city of Washington, in the District of Columbia, have made an improvement in carriages, by which the horses may be suddenly disengaged when running away, or whenever required to be detached from the carriage quickly; called the safety carriage; which is described as follows:

1, 2, 3



The swingletree is attached to the cross bar by an iron fixture called a jointed clasp, formed as in the annexed figure, (see fig. 1;) the knee part, marked A, resting against the back of the cross bar. This jointed clasp is held up against the under side of the cross bar by an iron shutter, or hinged clasp, formed thus, (see figure 2,) turning on a joint, or hinge, secured to the under side of the cross bar. To the end of the hinged clasp is attached an iron rod, or bolt, B, with an eye at its end. This rod, or bolt, passes through an opening in the cross bar, and has an iron spring key inserted through the eye, resting on the upper side of the bar, which secures the jointed clasp from dropping; or the rod may be fixed permanently to the cross bar, projecting far enough below it to pass through a slot or mortice in the end of the hinged clasp, with a spring key inserted through the end of the rod, or bolt, to prevent the hinged clasp falling. To the end of the spring key is attached a cord, which leads inside of the carriage, where it hangs loosely. Should the horse take fright, and become unmanageable, the cord is then to be pulled suddenly, which will draw the spring key from the eye of the rod, or bolt, let the hinged clasp fall, and with it the jointed clasp attached to the swingletree, and will disengage the horse from the carriage.

The tugs are open in front, thus, (see fig. 3,) to allow the breeching to slip off freely. This breeching is made from a single strap of leather, with rings sewed to the ends, to hook over the tugs. The shutter, or hinged clasp, may have its end turned up at right angles, and formed like a catch, or hook, and secured by a spring, fastened to the side of the cross bar, the cords being attached to the end of the spring, The shutter may, indeed, be held up in a great variety of modes, but the before described are sufficient to show the principles of my invention.

When it is desired to retain the swingletree, and let the horse go off with traces only, a hinged clasp must be put on each end of the swingletree, with the jointed clasps secured to the end of the traces, and the cords attached to the spring keys run through pulleys, and are joined to the cord which leads inside of the carriage.

In the two-horse carriage, the shutters, or hinged clasps, are hung on the under side of the wheppletree, and the cords attached to the spring keys run along on the top of the wheppletree in a straight line, then pass around pulleys, and are joined to the single cord which leads inside, or outside, of the carriage. The pulleys are to cause the cords to run freely, and to draw the spring keys, or pins, from the eyes of the rods, or bolts, in a straight line.

An iron tube, with a flaunch on one end, is fastened to the end of the pole. Over this is put a thimble, having a ring on each side, to which the breast straps are attached. This thimble slips off the end of the pole, when the horses are disengaged.

The mode of detaching horses from the two-horse carriage is similar to that described for a single horse carriage.

In a four-horse carriage the leaders are disengaged from the pole in the same manner, by a jointed clasp, hinged clasp, spring key, and cord, as described for a two-horse carriage. The jointed clasp may be held up against the cross bar by a pin inserted through the jointed clasp into the hind part of the cross bar, to which pin the cord is attached.

The jointed clasp may also be secured by a spring fastened on the hind part of the cross bar, the cord being attached to the end of the spring. Springs, or friction levers, are

secured to the carriage, brought in contact with the hub in order to decrease the motion of the carriage when the horses are liberated, or before they are liberated.

This invention may be applied to field artillery, and it will enable the men to limber or unlimber the gun in less than half a minute. It may also be applied to waggons of every description, to ploughs, and harrows, and all kinds of agricultural implements drawn by horses, when required to be taken in haste from the carriage to feed, &c.

A forked piece of iron is suspended over the hound and front axletree, to prevent its turning on the body bolt.

What I claim as my invention, and which I wish to secure by *letters patent*,, is the before described apparatus for suddenly disengaging horses from carriages.

For a further illustration of my invention I would refer to the models and drawings of the same deposited in the patent office.

Electrical Telegraph.—The following communication was handed to us by an intelligent foreigner, now in this city, relative to the transmission of intelligence between commercial cities, as New York and Albany, or New York and Philadelphia, for instance, by means of electricity. He has also explained to us his proposed plan of communicating or receiving intelligence between any two given points, however distant, almost instantaneously. The *principle* is by no means new; but the *application* of it to this important purpose has not been, that we are aware of, attempted by any person before. The inventor, Mr. Borch, of St. Croix—who has, as he informs us, secured a patent for his invention—thinks it may be applied with great ease to long lines of railroad.—[Amer. Railroad Journal.]

To the Editor of the American Railroad Journal.

Sir,—On the principle that the electric fluid can, by the means of an insulated conductor, be conveyed to any distance instantaneously, and that where there is any small opening in the conductor a spark will appear, which principle has been proved or established by numberless experiments, I have discovered a mode by which an instantaneous and reciprocal communicator of any intelligence from one place to another, at any distance, may be made. G. V. Borch.

P. S.—This communicator might especially be of great use in railroads.

Tanning.—The Salem (Mass.) Gazette mentions that Mr. K. Osborn, of Danvers, has made an improvement in tanning, and discovered a new article for fuel. He has recently put in operation a steam mill, for grinding bark, beating hides, and smoothing leather. The only fuel used is spent bark,, or tan, which has hitherto in tan yards been of no value. The engine, mills, and appurtenances, cost about two thousand dollars, and are equal to a grist-mill power. Tan has been long used in families in that vicinity as fuel, but its value has never before been fully tested. Its use at this mill proves a chord of it to be worth as much as a chord of white pine wood; one chord will grind six chords of bark; and that, with stoves and grates properly constructed, houses may be warmed, and all the cooking in families performed, with no other fuel, at a trifling expense.

New Gun introduced into England, by M. Jacques Auguste Demondion. [From the London Mechanics' Magazine.]

The gun is loaded and primed at one operation, and is cocked by lifting up the breech to introduce the cartridge.

The cartridge is of a peculiar kind; containing within itself a tube filled with detonating powder, which, exploding in the very middle of the cartridge, produces a better discharge. It requires a third less powder than common cartridges, and the bore of the gun is greater at the breech than at the muzzle, which makes it carry farther and more correctly.

From the peculiarities of the cartridges and barrel, the cartridges taken from the enemy can be immediately used for the new gun, but the new cartridges will not do for the pieces of the enemy.

The bayonet is more easily managed in exercising; is more difficult to be pulled off by an enemy; is longer, and the shoulder shorter than usual; therefore it is stronger; and being underneath the gun, instead of at the side, is more dangerous, and does not interfere with the aim: the charge is completely covered up, and protected from wet.

The gun is so easily managed, that with a few hours' practice a soldier will fire from 10 to 19 shots a minute; and can load and fire upright or lying down—marching or standing—one almost as well as the other. From not having to use his arm to load, he is less liable to be wounded by the enemy's shot; and for the same reason, the gun is particularly advantageous on board of ship. Moreover, it can be loaded easily in the dark.

And although more shots are fired in a

minute, the barrel does not heat so much as those of common guns, because at every shot there is a rush of air through it.

It is very strong, cannot be inadvertently double-loaded, and is free from many of the disadvantages of flint or percussion lock guns.

It is simple, and can be made by common workmen, and all its parts are of regular shape, so that they can be made by machinery, which will reduce its expense below that of ordinary guns.

It is easily cleaned, having neither cocks nor any complicated system of springs; and the ring that holds the bayonet on has a screw-driver on it to unscrew the parts.

Railways—The following able, yet not more able than true, exposition of the advantages of railroads, is from the *Edinburgh Review*. It is but a plain statement of facts, yet they are so *clearly* and *forcibly* stated, that they can hardly fail to convince those who still doubt the truths therein set forth. We should be gratified to see them extensively copied.

"Railways are in progress between the points of greatest intercourse in the United Kingdoms, and travelling steam engines are in preparation in every quarter, for the common turnpike roads; the practicability and utility of that application of the steam engine having not only been established by experiment to the satisfaction of their projectors, but proved before the legislature so conclusively, as to be taken for the foundation of parliamentary enactments.

"The important commercial and political effects attending such increased facility and speed in the transport of persons and goods, are too obvious to require any very extended notice here. A part of the price (and in many cases a considerable part) of every article of necessity or luxury, consists of the cost of transporting it from the producer to the consumer; and consequently every abatement or saving in this cost must produce a corresponding reduction in the price of every article transported; that is to say, of every thing which is necessary for the subsistence of the poor, or for the enjoyment of the rich, of every comfort, and of every luxury of life. The benefit of this will extend, not to the consumer only, but to the producer; by lowering the expense of transport of the producer, whether of the soil or of the loom, a less quantity of that produce will be spent in bringing the remainder to market, and consequently a greater surplus will reward the labor of the producer. The benefit of this will be felt even more by the agriculturist than by the manufacturer; because the proportional cost of transport of the produce of the soil is greater than that of the manufactures. If 200 quarters of corn be necessary to raise 400, and 100 more be required to bring the 400 to market, then the net surplus will be 100. But if by the use of steam carriages the same quantity can be brought to market with an expenditure of 50 quarters, then the net surplus will be increased from 100 to 150 quarters; and either the profit of the farmer or the rent of the landlord must be increased by the same amount.

"But the agriculturist would not merely be benefitted by an increased return from the soil already under cultivation. Any reduction in the cost of transporting the produce to market, would call into cultivation tracts of inferior fertility, the returns from which would not at present repay the cost of cultivation and transport. Thus land would become productive which is now waste, and an effect would be produced equivalent to adding so much fertile soil to the present extent of the country. It is well known that land of a given degree of fertility will yield increased produce by the increased application of capital and labor. By a reduction in the cost of transport, a saving will be made which may enable the agriculturist to apply to tracts already under cultivation the capital thus saved, and thereby increase their actual production. Not only, therefore, would such an effect be attended with an increased extent of cultivated land, but also with an increased degree of cultivation in that which is already productive.

"It has been said that in Great Britain there are above a million of horses, engaged in various ways, in the transport of passengers and goods, and that to support each horse requires as much land as would upon an average support eight men. If this quantity of animal power were displaced by steam engines, and the means of transport drawn from the bowels of the earth, instead of being raised upon its surface, then, supposing the above calculation correct, as much land would become available for the support of human beings as would suffice for an additional population of eight millions, or, what amounts to the same, would increase the means of support of the present population by about one-third of the present available means. The land which now supports horses for transport, would then support men, or produce corn for food.

"The objection that a quantity of land exists in the country capable of supporting horses alone, and that such land would be thrown out of cultivation, scarcely deserves notice here. The existence of any considerable quantity of such land is extremely doubtful. What is the soil that will feed a horse, and not feed oxen or sheep, or produce food for man? But even if it be admitted that there exists in the country a small portion of such land, that portion cannot exceed, nor indeed equal, what would be sufficient for the number of horses which must, after all, continue to be employed for the purpose of pleasure, and in a variety of cases where steam must necessarily be inapplicable. It is to be remembered also, that the displacing of horses in one extensive occupation, by diminishing their price, must necessarily increase the demand for them in others.

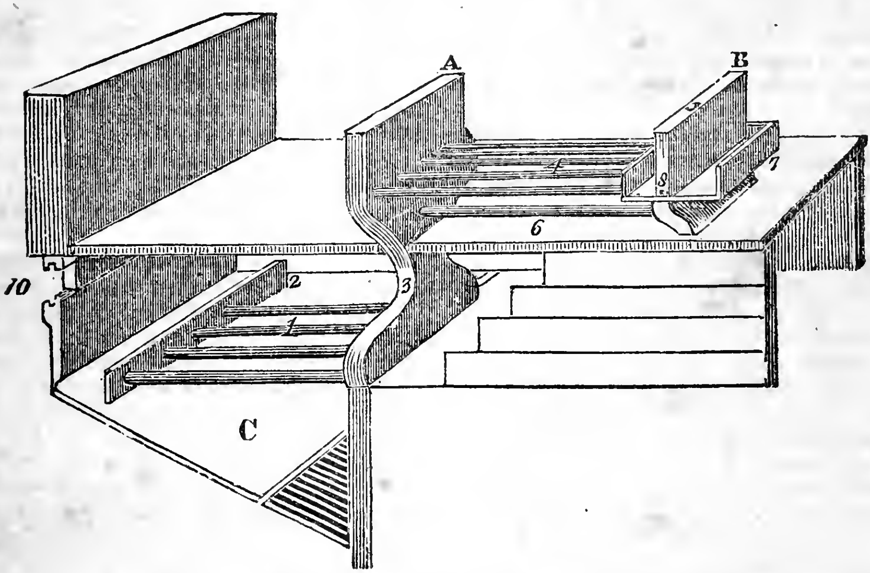
"The reduction in the cost of transport of manufactured articles, lowering their price in the market, will stimulate their consumption. This observation applies of course not only to home but to foreign markets. In the latter we already, in many branches of manufacture, command a monopoly. The reduced price which we shall attain by cheapness and facility of transport, will still further extend and increase our advantages. The necessary consequences will be an increased demand for a manufacturing population; and this increased population again re-acting on the agricultural interests, will form an increased market for that species of produce. So interwoven and complicated are the fibres which form the texture of the highly civilized and artificial community in which we live, that an effect produced on any one point is instantly transmitted to the most remote and apparently unconnected parts of the system.

"The two advantages of increased cheapness and speed, besides extending the amount of existing traffic, call into existence new objects of commercial intercourse. For the same reason that the reduced cost of transport, as we have shown, calls new soils into cultivation, it also calls into existence new markets for manufactured and agricultural produce. The great speed of transit, which has been proved to be practicable, must open a commerce between distant points in various articles, the nature of which does not permit them to be preserved so as to be fit for use beyond a certain time. Such are, for example, many species of vegetable and animal food, which at present are confined to markets at a very limited distance from the grower or feeder. The truth of this observation is manifested by the effects which have followed the intercourse by steam on the Irish Channel. The western towns of England have become markets for a prodigious quantity of Irish produce, which it had been previously impossible to export. If animal food be transported alive from the grower to the consumer, the distance of the market is limited by the power of the animal to travel, and the cost of its support on the road. It is only particular species of cattle which bear to be carried to market on common roads, and by horse carriages. But the peculiar nature of a railway, the magnitude and weight of the loads which may be transported on it, and the prodigious speed which may be attained, render the transport of cattle of every species, to almost any distance, both easy and cheap. In process of time, when the railway system becomes extended, the metropolis and populous towns will therefore become markets, not as at present to districts within limited distances of them, but to the whole country.

"The moral and political consequences of so great a change in the powers of transition of persons and intelligence from place to place are not easily calculated. The concentration of mind and exertion which a great metropolis always exhibits, will be extended in a considerable degree to the whole realm. The same effect will be produced as if all distances were lessened in the proportion in which the speed and cheapness of transit are increased. Towns, at present removed some stages from the metropolis, will become its suburbs; others, now at a day's journey, will be removed to its immediate vicinity; business will be carried on with as much ease between them and the metropolis, as it is now between distant points of the metropolis itself. The ordinary habitations of various classes of citizens engaged in active business in the towns, will be at what are now regarded considerable distances from the places of their occupation. The salubrity of cities will thus be increased by superceding the necessity of heaping the inhabitants together, story upon story, in a confined space; and by enabling the town population to spread itself over a large extent of surface, without incurring the inconvenience of distance. Let those who discard speculations like these as wild and improbable, recur to the state of public opinion at no remote period on the subject of steam navigation. Within the memory of

persons who have not yet passed the meridian of life, the possibility of traversing by the steam engine the channels and seas that surround and intersect these islands, was regarded as the dream of enthusiasts. Nautical men and men of science rejected such speculations with equal incredulity, and with little less than scorn for the understanding of those who could for a moment entertain them. Yet we have witnessed steam engines traversing, not these channels and seas alone, but sweeping the face of the waters round every coast in Europe, and even ploughing the great oceans of the world. If steam be not used as the only means of connecting the most distant habitable points of our planet, it is not because it is inadequate to the accomplishment of that end, but because local and accidental causes limit the supply of that material from which at the present moment it derives its powers."

Hot Air Blast.—It is stated that the weekly consumption of coals at the Clyde Iron Works has been reduced, by the adoption of the heated blast, from 1800 to 600 tons; while, at the same time, a greater quantity of iron has been manufactured.



Heating Green-Houses and Dwellings by Hot Water. By Mr. M. Saul, Florist. To the Editor of the New-York Farmer.

Sir—I herewith send you my plan for heating by hot water. To save time and room, I have sent part of the London Mechanics' Magazine, which was published May 19, so that you may select what part you think proper, and the above plan I have drawn expressly for your work, which will be of greater power than the one in the Mechanics' Magazine, or Gardeners' Magazine. Whether the hot water system is in use in America, I know not; but the following plan will repay the expense. The fire-place is on the same principle as Witty's Improved Furnace, in the Gardeners' Magazine, volume 7th, page 482. It is founded on the modern discoveries in chemistry, and forms so beautiful an instance of the application of scientific principle to the useful arts, that I shall attempt to give your readers an idea of it. Coal, when dry, if submitted to distillation, or in other words exposed to greater heat, emits a large quantity of aqueous vapor and inflammable gas, and becomes coke, which consists, when the coal is pure, almost entirely of carbonaceous matter. My fire-place is an inclined plane, and terminated by a grate, and I also find that it is of no consequence whether the grate is fixed or movable, like Witty's.

As the fire begins to burn at the lower end, and which is supported by air admitted through the grate, the coal, while it lies on the under surface of the inclined plane, and before it reaches the grate, undergoes a dry distillation, and the steam and gas which are thus expelled occupy the space above the coal. At the same time the coal which has

already undergone this process, and in the shape of coke has reached the grate, is burning, and the air which passes through this coke fire, heats to a very high temperature, sweeps over the surface of the unburnt coal, or the inclined plane, and inflames all the gas as it is evolved. Thus the gaseous matters evolved from the coal are converted by combustion into gaseous vapors, thereby forming steam, and carried off through the flues, which are connected, diffusing heat wherever it is required without being accompanied with a single particle of smoke, which is a great advantage to hot-house plants. Wood might be burnt in this fire-place the same as coal.

My plan of increasing the heat by the same fire is on the same principle of a locomotive steam engine, which is, I have found to be, very great, having no boiler or cistern, but tubes in the fire, which is the reason our Liverpool railway carriages have such great power.

References.—1, the tubes, 21 inches long, $1\frac{1}{4}$ inches inside—these tubes put the water in motion as soon as the fire is kindled; 2, supports the tubes; 3, the conductor through the top of the flue; 4, the upper pipes for the hot water, which is carried forward with great power to 5, and returns through the pipe, 6, which is about 3 inches inside; 7, the reservoir, for supplying the waste—it supplies itself by a small aperture at 8—a loose plug is fixed so that the water gets in, and prevents the whole force of the hot water entering the reservoir, which would cause too great a steam in the house—by the stroke, as described in the other plan, I have removed one end of the reservoir, to show the place where it supplies the pipes, at 8; I have removed the brick-work at the side of the fire, to show the tubes; 10, there is a sliding door for feeding the fire, as described in the other plan; C is the fire-place, also described in the other plan; A B, to be considered as running all the length of the front flue.

You will not perhaps have seen in the Gardeners' Magazine a plan of a hot water cistern being fixed on the top of the flue; you will therefore select what part of this communication you think proper, as you will have observed in the last number of the Gardeners' Magazine a notice of Perkins' mode of heating by hot water, and I suppose you will have a description of it in the next number for June: so that you may judge for yourself. I wrote to Mr. Loudon to wish him to furnish me with the time it took in getting the water to the boiling point, in Perkins' mode of heating, so that I might judge fairly of it, as I have got a drawing of Perkins', which appears to me not so good as Mr. Loudon thinks of it.

I remain, yours, &c. M. Saul.

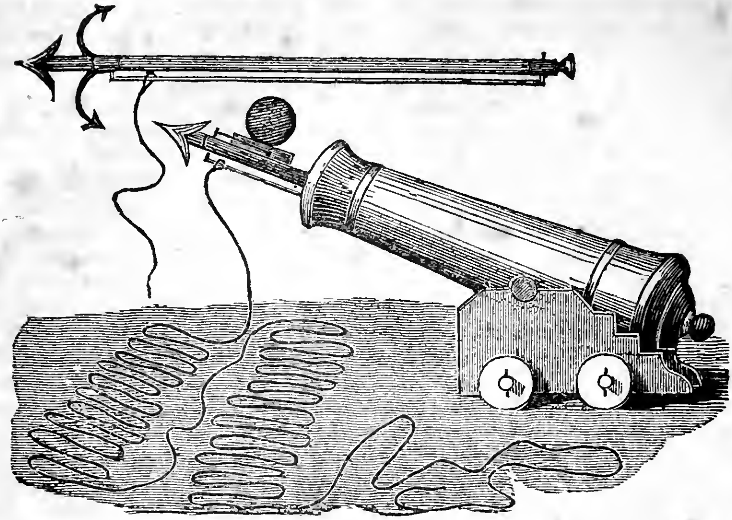
Lancaster, England, May 29, 1832.

Foot Railroads. By Publicola. [From the American Railroad Journal.]

Mr. Editor,—Those inventions are the most important which enable all classes of society to make the best use of their personal strength. Railroads for the use of individuals, like a foot path, will do this. Stages, steamboats, and railroads for steam and horse carriage, will never do half the conveyance of passengers and goods over the country. Large railroads must necessarily be confined to great channels of communication: they require too great capital to be extended to every village. It is stated that to move a weight of a ton on a level railroad requires but the strength that is requisite to raise up eight pounds over a pulley. To move 500 lbs. on a level railroad, would require then only the strength necessary to raise up two pounds over a pulley. Carriages of about the weight of a wheel-barrow, or less than fifty pounds, might be made for what I shall call a foot railroad. Probably the families that go to country stores do not carry generally more than 100 lbs. weight; and most commonly they do not carry more than 50 lbs. But suppose that it is 100; then there is a carriage of 50 and a load of 100 lbs. The force required to move this on a level railroad will be only a small fraction more than that required to raise half a pound over a pulley. And then there is a level path to walk on. If there are departures from a level, some more strength must be exerted at the ascending planes; but then the traveller can rest on his carriage at the descents. In fact, according to the principles of mechanics, as easily as a man of 140 pounds weight can travel up a hill 50 feet high, he can move forward a load of 280 pounds a mile and a quarter on a level railroad. It will appear, then, that foot railroads will be a vast public benefit: an advantage not to the rich only, but chiefly to the laboring classes.

Mr. Murray's Invention for Saving from Shipwreck. [From the London Mechanics' Magazine.]

Several ingenious methods have been proposed for effecting a safe communication between stranded ships and the shore. Mr.



Trenghouse suggested a rocket, Capt. Dansey a kite, and Capt. Manby a shell, for the purpose of carrying out a line to the ship in distress. The plan of Captain Manby was thought so well of at first, that it was honored with a Parliamentary reward, and very great exertions have been made to introduce it into general use. But it has been found attended with so much difficulty, even under the most favorable circumstances, and has in not a few instances failed so decidedly, that it has been only very partially adopted, and has not effected any material diminution in the general loss of life by shipwreck. From the weight of Captain Manby's apparatus, it is not quickly transportable from the few stations which are provided with it, to the immediate scene of danger; and when the rope is projected, it too frequently snaps in two. A transport was wrecked only three miles from Mundesley, where there was one of Captain Manby's safety-mortars, but before it could be conveyed to the spot, the ship had gone to pieces, and all on board perished. In another case, of a ship wrecked off Whitby, in 1820, within 60 yards of the shore, the shot, in the first attempt, fell short; the rope, in the second, broke; and the ship and crew were buried in the breakers. On many parts of the coast there is not even this imperfect apparatus of Captain Manby. So late as December, 1830, one of the most frequented, and, at the same time, most dangerous parts of the British coast—that between Plymouth and the Land's End—was so entirely destitute of every sort of means for saving shipwrecked mariners, that of the passengers and crews of 28 vessels which went on shore in the dreadful storm of that month, only two men and a boy were saved!

Frequent reflection on these distressing facts has led Mr. John Murray (the popular lecturer on chemistry, and the author of many excellent scientific works,) to the invention of the apparatus represented in the prefixed engravings, and described in the pamphlet which we have now before us.* Mr. Murray first tried to project from a common musket an arrow with a line attached to the feather end, but the arrow became *reversed* in its transit through the air, and the following improved and very ingenious arrangement was therefore adopted:

"The highest figure represents the form of the arrow, as best constructed for the common blunderbuss, and may be propelled immediately from the shore, or carried with the life-boat. The butt-end carries a thin metallic shield, or plate, which may be made of copper. The point is sharp and barbed, to fasten where it may strike, or act as a hold-fast on the tackling or rigging of the wreck. It is shod with iron, as well to subserve this purpose as to secure its direction, and compete with the resistance it must encounter in a storm. The wood used is hickory, or ash, or, still better, lance-wood—the more cohesive the fibre the better: this is withed in its extreme length with whip thread or line; bands or ribbons of thin metal

* Invention of an Effective and Unfailing Method for forming an Instantaneous Communication with the Shore in Shipwreck; and Illuminating the Scene in the Dark and Tempestuous Night. By John Murray, F. S. A. &c. 30 pp 8vo. Whittaker & Co.

strengthen the arrow, where the bent extremities of the parallel iron rod pass through, and which last are further secured by a shoulder on one side and a nut on the other. Along this parallel rod glances the iron ring, to which the line is attached, the instant it leaves the gun, and a bit of cork, or caoutchouc, toward the end of the arrow, interposed between the rod and the body of the arrow, acting as a recoil spring, will so far subdue the effect of friction.

"The entire weight of the arrow, thus plumed and shod, is from two to three ounces, 18 inches long, and three quarters of an inch in diameter. These dimensions and weight have been found most efficient and successful when applied to a blunderbuss sixteen inches long in the barrel, and one and one-tenth inch diameter in the calibre. The entire weight of the arrow and its appendages, together with the strong whip-cord attached to it, was two pounds and one ounce, and were carried to an extent of nearly one hundred yards by two drachms of gunpowder. The cord was of sufficient strength to pull a rope from the shore large enough to form a communicating medium of escape from the wreck.

"The lowest figure exhibits the arrow applied to a three-pounder swivel, the calibre of which, however, though not represented in the plate, it ought nearly to fill. In this case, the arrow and its various adjustments weigh together nearly two pounds; and with three ounces of gunpowder, a line of considerable strength and power will be propelled upwards of a hundred and fifty yards. In this instance a macharel, or deep sea-line, may be used. The cord is represented as coiled in the form of what is called French faking, and was the plan adopted in all our experiments, while it seems best adapted to preserve the coils from being entangled—a circumstance of the highest importance in experiments of this description. The barb is removed here to render the appearance less complicated.

"The arrangement is supplied with an appendage for illuminating the flight of the arrow and scene of shipwreck. It consists simply of a cylindrical sheath, or socket, containing the materials of illumination, consisting of a mixture of finely powdered chlorate of potassa and sugar-candy intimately blended together. A spindle supplied externally, with a flat head, enters by its extreme head into a miniature phial supplied with sulphuric acid, sealed with a drop of bees' wax. As soon as the arrow leaves the gun, the reaction of the air on the head of the spindle drives inward the plug of wax and liberates the acid, which instantly kindles the mixture, the brilliant flame immediately fills the globular car of wire gauze which surmounts it, and the intensity of the light is rendered still more dazzling and splendid by adding a bit of phosphorus to the inflammable powder. This part of the apparatus is made altogether independent of the arrow, and may be easily attached when circumstances require it, as when the darkness of the night renders it imperative. The combustion, which forms the source of the illumination, cannot be quenched either by the sea spray or a deluge of rain, the medium of support being supplied from itself, altogether independent of the external atmosphere, however charged with watery vapor or rain, and the combustion is too fierce to be at all affected by the wind, even at its maximum degree of strength."

The "experiments" alluded to in the preceding extract are detailed more at length in a subsequent part of the pamphlet, and leave no doubt on our minds, that Mr. Murray's apparatus is by far the most efficient that has been yet devised; while, at the same time, it is so cheap and portable, that inclination alone is all that can be wanting to bring it into general use.

Ale from Mangel Wurtzell.—A writer in the New Monthly Magazine states that, from numerous experiments, he finds that an excellent ale may be brewed from this root in the proportion of fifteen pounds weight of it to the gallon of water, with the addition of two pounds weight of molasses to the firkin. One-third of malt and mangel wurtzell liquor will make a capital ale, so that even in this way a great saving might be effected. The method of brewing adopted by the writer is thus described: "First wash (or rather pare) off the outer rhind, slice and boil them until soft and pulpy, squeeze the liquor from the pulp as much as possible, and then boil it again with about six ounces of hops to nine gallons, and work with yeast in the usual way."

The leaves of the mangel wurtzell stripped from the plant in August or September are valuable food for the cow or pig, not retarding the growth of the plant in the least, the culture of the plant is very simple; the seeds should be placed on well manured ridges, eighteen inches apart, and six or eight inches between the plants; hoeing down and keeping them free from weeds.

On estimating the Performances of Locomotive Engines. By V. D. G. [From the American Railroad Journal.]

The Treatise on Railroads written by Nicholas Wood, contains a table exhibiting the performance of certain locomotive engines, moving with different loads, and upon planes of different inclinations. This subject is an interesting one to the practical engineer; and to the speculative mathematician it presents a problem for investigation.

The principal difficulty in estimating the performance of these engines, is the uncertainty which seems to exist with respect to the amount of the loss of leverage under which the pressure of the steam in the cylinders must act, in communicating motion to the travelling or adhesion wheels. For, with respect to steam engineers in general, a great source of loss in power arises from the oblique action of the connecting rods in communicating a rotary motion to the crank.

Some of the English engines, according to the above named treatise, are capable of exerting a motive force equal to 30 per cent. of the whole pressure of the steam upon the pistons. But it will appear from the following remarks, that an estimate of 30 per cent. much exceeds the truth. Indeed, as the effective pressure will vary with the length of stroke, and the diameter of the adhesion wheels and other things, it is impossible from any principles which would seem to have been contemplated by Mr. Wood, to make any just estimate of the effective pressure of the steam in engines differently constructed in those respects. The loss of effect, as far as the crank alone is connected, is susceptible of being determined by a strict mathematical investigation. For the object of inquiry will evidently be to ascertain what must be the value of a constant and uniform force, which, acting at the extremity of the crank, in the direction of its motion, will communicate the same momentum, in the time of one complete revolution, as is communicated by the variable pressure of the connecting rod, in the same time.

The differential and integral calculus renders this an inquiry of easy solution. I take the following notation: $P =$ given force or pressure of the steam upon the piston; $P' =$ pressure communicated from the piston to the connecting rod; $P'' =$ pressure communicated from the connecting rod to the extremity of the crank, in the direction which produces a motion of rotation; $P''' =$ effective pressure of the steam upon the crank, or an uniform pressure, required to act upon the extremity of the crank, in the direction of its motion, in order to generate the same momentum in a given time, as is generated in the same time by the variable pressure P''; $k =$ length of the connecting rod; $h =$ length of the stroke of the piston.

There are evidently two points in each revolution of the crank, which gives $P'' = o$; and two other points *nearly* in the middle between the former, which gives P'' a *maximum.* Take, therefore, a circular arc z, to radius unity, containing the angle between the position of the crank at any time, and the remote point where $P'' = o$.

The quantity of motion, communicated to the crank by the pressure P'' in an instant of time, is, agreeably to the principles of dynamics, represented by $P'' \times dz$; and therefore the whole quantity of motion, communicated to the crank, in describing the arc z, will be represented by the integral of $P'' \times dz$. But the whole quantity of motion which the constant pressure P''' would generate in describing the same arc, is in like manner represented by $P''' \times z$.

When, therefore, those two quantities of motion are made equal, the general expression is,

$$P''' = \frac{\text{Integral of } P'' \times dz}{z}$$

Taking an arc A, whose sine is $\frac{h \sin z}{2k}$, it follows from the principles of mechanics, that $P' = P \times Cos.\ A$; and also, that $P'' = P' \times \sin (z - A)$. Hence,

$$P'' = P \times Cos.\ A \times \sin (z - A).$$

Substitute for *Cos.* A and *sin* A, their values; expand $\left\{ 4k^2 - h^2 \sin^2 z \right\}^{\frac{1}{2}}$ into a series; and because $2k$ is always much greater than h, omit all quantities which contain $\frac{h}{2k}$ beyond the first power; multiply by dz, and integrate. The result, when $z = 180°$, is very nearly $P''' = \frac{2}{3}P$. And hence the following general

THEOREM:—A rotary motion being communicated to a crank, from the oscillations of the piston rods of a steam engine, by means of connecting rods much longer than the length of the crank: I say, the effective force upon the crank, during each complete revolution, abstracting from inertia and friction, is equivalent to a constant and uniform pressure of very nearly two-thirds of the whole force of the steam upon the piston rods, acting at the extremity of the crank, in the direction of its motion.

Having now found the effective pressure upon the crank, it is easy to determine what part of the whole force of the steam upon the pistons is communicated to the periphery of the adhesion wheels of the engine.

Let r be the radius of those wheels, and take E to represent the force communicated to the peripheries thereof. The principle of virtual velocities gives $E : P''' : :$ velocity of the extremity of the crank : velocity of the periphery of the adhesion wheels. But in uniform motion, the velocity is as the space directly and time inversely; and supposing the gearing of the engine to be such, that each ascent or de-

scent of the piston, produces $\frac{1}{u}$ part of a revolution of the adhesion wheels, the time of one revolution of the crank, will be $= \frac{2}{u} \times$ time of one revolution of the adhesion wheel. It thus follows that $E : P''' :: \frac{h}{2} : \frac{2r}{u}$; or, $E = P''' \times \frac{uh}{4r}$; and substituting for P''' its value $\frac{2}{3}$ P, the following practical formula is at once obtained, viz.:

$$E = P \times \frac{uh}{6r}$$

In the "Planet" engine, described by Mr. Wood, the following values obtain, viz.: $r = 2.5$ ft. $h = 1.33$ ft. and $u = 2$; and, therefore, in this case $E = P \times \frac{8}{45}$: showing that engine to be capable of yielding an effective pressure of only about 17 per cent. of the whole pressure upon the pistons, even without regard to inertia and friction. This engine is stated by Mr. Wood to be capable of yielding an effective pressure of upwards of 30 per cent.! Indeed, the effective pressure of the English engines appear to be much overrated by Mr. Wood, as will be seen from an application of the above formula.

In an engine recently constructed for the Lexington and Ohio Railway, the following values are given, viz.: $r = 1.5$, $h = 1.5$, and $u = 2$; and, therefore, $E = P \times \frac{1}{3}$; indicating an effective pressure of 33 per cent. when inertia and friction are not considered.

Let T = force of traction in lbs. which an engine may be required to exert upon its own carriage and upon the load; f = a force of traction in lbs. which is equivalent to the inertia and friction of the machinery of the engine; c = surface area of pistons in sq. feet; p = pressure per sq. inch upon the pistons; b = gallons of water which the boiler is capable of evaporating into steam per hour; v = rate of travelling in miles per hour.

From known principles the following formula is soon obtained, viz.:

$$v = \frac{15br}{4\,uchp}$$

The whole pressure upon the pistons is denoted by $144pc$; and therefore $144pc \times \frac{uh}{6r}$ = effective pressure, without inertia or friction; or, $144\,pc \times \frac{uh}{6r} - f = T$; and eliminating p, the result is,

$$p = \frac{r \times (T + f)}{24\,c\,u\,h}$$

Substituting this value for p, in the expression for the value of v given above, the following general formula is the result, viz.:

$$v = \frac{90\,b}{T + f}$$

Taking the case of the engine "Atlantic," as given in a report of the chief engineer of the Baltimore and Ohio Railway, the following values obtain, viz.: $b = 300$ gal. $f = 450$ lbs. and the adhesion of the wheels = 1120 lbs. In this case therefore, $v = \frac{27000}{1570} = 17\frac{1}{5}$ miles per hour, being the velocity with which this engine will travel when exerting a force of traction equal to the adhesion of its wheels; the same result as given in said report very nearly.

A general expression has thus been investigated, for determining the velocity with which a given locomotive will be capable of travelling, when it has to effect any given force of traction. But upon curves the traction will vary with the velocity, in which case a different formula will be required. Let w denote the weight in lbs. of an engine capable of moving a load with the carriages, whose weight in lbs. is W, with a velocity v in miles per hour, upon a curve whose radius in feet is R, and upon a grade whose ascent or descent in a distance unity is n, and in carriages whose moving friction is m.

The following is then the general formula:

$$V^3 + V \times 60R. \left\{ m \pm n + \frac{f}{w + W} \right\} = \frac{5400\,R\,b}{w + W}$$

Which cubic will give the velocity when the engine moves under circumstances of various loads, grades, and curvatures. The investigation I omit for want of room in this Journal, and will only observe, that it is easily obtained from the preceding.

Should the calculations given above be found, upon further examination, to be defective in principle, still it is hoped that they may be the means of suggesting to the scientific engineer some hint which may guide him in the pursuit of an investigation leading to results more consonant with experience; and thereby enable him to estimate the performance of any proposed locomotive engine, from the pressure and quantity of steam given, with more precision than seems to have been hitherto understood.

V. D. G.

Lexington and Ohio Railroad,
18th Dec. 1832.

Steam Engine.—The following very extraordinary performance of a locomotive engine, on the Philadelphia, Germantown and Norristown Railroad, is taken from the Philadelphia National Gazette. According to this description Mr. Baldwin has outdone all who have constructed locomotives before him; and we may say also, the most sanguine anticipations of the friends of railroads. At 60 or 40, or even 20 miles the hour, a complete revolution would be effected in the mode of doing business; and it will be done, too, before many years.

"The extraordinary speed and power of the locomotive on the Germantown Railroad should excite more attention than it has obtained from

the enlightened community in which it has been made. It is the more remarkable because it is in many points original, and because it is the very first working engine of the locomotive kind made by Mr. Baldwin, and yet it has surpassed, in fleetness and proportional working power, any engine of whose performance we have been able to find any authentic account. In the celebrated trial of speed and power on the Liverpool and Manchester Railroad, the "Novelty," of Braithwaite and Ericsson, took the palm for swiftness, and the "Rocket," of Stephenson, that for power and efficiency. The former has not been since heard of, because of its want of adaptation to useful purposes, whilst the slower engines of Stephenson have been at work on almost every English railroad. According to the partial estimate of its friends, the Novelty, *on that fine railway, cleaned for the occasion, and on a set day of trial,* ran a mile in a minute, while Stephenson's engine requires a minute and a quarter to pass over the same space, or travelled on a straight and level road at the rate of 40 miles per hour. At present his locomotives take an hour and ten minutes to go the thirty miles between Low-hill and the depot at Manchester. In the trials recently made on Mr. Baldwin's engine, the road was muddy, so as to impair the grip, and to lessen the smoothness, and she was used immediately after her return from her afternoon trip to Germantown. For the experiment a space of two miles and a quarter was selected, in which there are four curves, and several very muddy cross-ways. In passing through this space the steam was *cut off at each curve* so as to *visibly* lessen the speed, and yet the whole distance was passed over in 3 minutes and 3-8ths. It was therefore done at the rate of 40 miles per hour. On the straight lines the speed seemed much greater, but no estimate of it was then made. On a subsequent day, however, when Dr. Patterson, of the University of Virginia, was in the 'tender,' the mile on a straight line was run through in 58 seconds, according to the estimates of one computer, whilst another observer of time counted 52 seconds. That the distance might have been run in less time was obvious to all, for Mr. Baldwin made the engineer cut off the steam entirely, to check a career which he feared might become too great for the strength of the road, or the tenacity of the parts of the locomotive. At 58 seconds, the speed was more than 62 miles per hour. From this rapid movement no inconvenience was felt by the passengers: but a stiff breeze was produced by the quick motion through the air, so as to endanger the security of the hats.

"By the contract the weight of the engine was, we understand, limited to 5 tons, so that on a muddy rail the weight is not such as to secure a grip for a very long and heavy train of cars. What the engine could draw on a clean road cannot be well ascertained, for another reason. The rails not being inclined laterally, the space pressed by the inclined rim of the wheels is very limited; but when over-loaded, the engine has shown her great power by turning her wheels on the rails, whilst the grip was not adequate to the propulsion of her load. By this we perceive that she can pull as much as it is possible for any engine of the same weight to pull on that road.

"Although formed on the basis of Stephenson's engine, Baldwin's is superior in simplicity and compactness. The boiler is lighter in front; the pumps are formed in the guide rods; there is but one rod and rock shaft attached to the main valve; the throttle valve is a sliding one, placed close to the station of the engineer, and managed by a very short rod and lever. The eccentric has no lateral motion, but is reserved by moving the rod to the opposite side of the centre of motion of the rock-shaft.

"Power and fleetness having been adequately obtained, simplification was that for which Mr. Baldwin sought, and in that he has succeeded so well as to leave little if any room for more pruning. The arrangements are such, too, as to enable the engineer to observe and correct defects without penetrating to the interior of the boiler. A manhole is therefore unnecessary.

"On the whole, as the first instrument of its kind, containing so many new points, and issuing from the hands of a mechanic who never before constructed such a machine, its strength, ease of motion and fitness, must appear remarkable. As far as our opportunity of judging goes, we are warranted in esteeming this engine the best that has yet been constructed in any country, and fully capable of going at the highest speed compatible with comfort or safety." M.

The following account, which we copy from the Mechanics' Magazine, of the first attempt to use steam for propelling vessels in England, brings forward a new claimant to the honors of that important discovery. It is an honor *well worth* contending for—"Honor to whom honor is due," is our motto.

History of Steamboats—*New Claimant to their Introduction.*—Mr. Wm. Bromilow, a correspondent of the Liverpool Chronicle of Saturday last, has brought forward a new claimant to the introduction of steam navigation in the person of John Smith, late of St. Helen's.—Indeed, the facts, if authentic, leave no doubt that he has a prior claim to both Bell and Fulton. Mr. Bromilow's statement is as follows:

"The engine in the boat alluded to, and which is generally supposed to be the first invented, was constructed for propelling boats by steam, as before stated, by Smith at St. Helen's, in the year 1793, and her first excursion was down the Sankey Canal to Newton Races, in June in the same year, laden with passengers. On the Saturday following she sailed to Runcorn, from thence down the Duke of Bridgewater's Canal,

to Manchester. On her arrival there, such was the astonishment and curiosity at this wonderful, and, as some would have it, this mad idea, that thousands of the people came from all directions to see what their eyes would not believe, nor their senses understand; and, indeed, such were the numbers, and such the curiosity this vessel excited, that Smith was obliged, for the safety of his property, to give notice that no one would be allowed to come on board of her, excepting those who paid a certain sum. This exasperated the populace to such an extent, that a party of mechanics immediately got possession of, and almost destroyed her. Amongst the visitors was Mr. Sherratt, of the firm of Bateman and Sherratt, of Manchester; also several other respectable engineers of the same place, whom it is unnecessary to name. So far as memory serves me, (after a lapse of 39 years,) the following is a short description of this wonderful discovery; but having made no memorandums of the circumstance at the time, and, I may say, being then young, and to a certain extent, like the rest of my friends, incredulous, I never anticipated what is almost to every one in the present day so common. The vessel had on her an engine on the old atmospheric principle, was worked with a beam, connecting-rod, double crank, in an horizontal line, and with seven paddles on each side, which propelled her at the rate of about two miles an hour. John Smith was a rude, uncultivated, self-taught mechanic, and was supported with money by a Mr. Baldwin, at that time of St. Helen's, and was the first æronaut who ever ascended in a balloon, either in this or the adjoining counties. Perhaps, I may observe, that the vessel or boat was purchased at Liverpool, and on Smith's informing the parties from whom he bought it what his intentions were, he was treated as some insane person: he was laughed at by one, insulted by another, and pitied generally; but, having money with him, he was allowed to purchase her. On being questioned and laughed at by a merchant at the time the purchase was made, he replied, '*Those may laugh who will, but my opinion is, before twenty years are over, you will see this river* (Mersey) *covered with smoke.*'

"I feel pleasure in giving you these particulars, and the substance of the remarks I can vouch for as being correct, having been an eye-witness to most of them, and one of the party who took his first excursion."

New Steam-Carriage.—A steam-carriage, constructed by Col. Macirone and Mr. J. Squire, Paddington wharf, and which professes to be, by the superiority of its peculiar boiler, and the simplification of its machinery, a decided improvement on all former vehicles of that description, has been exhibited for some time past in the neighborhood of Paddington. We drove out in it a few days ago along the Harrow-road, with, in all, 11 persons. The utmost velocity on level ground was near 10 miles an hour; a part of the road covered with a coating of loose wet pebbles was crossed at a rate of about 8 miles; and the bridge over the Grand Junction Canal, where the steep is rather a smart one, at 4 or 5 miles an hour. It ought to be observed that at this time the first fire was burning, and that therefore the boiler might not have been heated to its maximum. The jolting was not much greater than an ordinary stage-coach. When moving rapidly, the noise of the engine was lost in that of the carriage, but observable to the passengers as soon as the speed diminished. Some of the horses on the Harrow-road shied on seeing it.

The appearance of the vehicle, its boiler and grate being covered with a casting of sheet iron, and surmounted by a short chimney, seemed to be the cause of this, as there was no smoke perceptible. But on running down the Edgware-road, followed by a delighted crowd of boys and girls, it caused no alarm to the horses there. The command of the conductor over it was remarkable. Its speed was readily diminished, short turns were made with apparent ease, and hills were descended at a satisfactory pace. The whole distance travelled was about five miles, and, in performing this, 3-4ths of the first supply of coke was expended. We were not able to witness the results of the second fire.

On setting out, the proprietor stated that the pressure on the boiler was 300 lbs. the square inch, and the pressure on the pistons nearly the same. The weight of the whole vehicle when ready to move, with its supply of fuel and water was stated by him at $2\frac{1}{4}$ tons. Weight of the boiler 17 cwt., thickness 3-16ths of an inch, usual quantity of water in it 20 gallons, utmost distance ever travelled with one supply of fuel and water near 12 miles, utmost cost of fuel per mile 3d, diameter of the (two) pistons 7 inches each, piston stroke 16 inches, the length of the steam-pipe, which he asserts does not affect the power at the working point, seemed to us about 12 feet. Descending from the boiler, it turns horizontally, runs under the body of the vehicle to the conductor's seat, then turns backward at rather a sharp curve, and enters the cylinders.

The pistons are connected with a frame, which rests on one pair of very free elastic springs, placed at the front of the carriage. The boiler rests on much stronger ones, but also elastic. It may be necessary to mention this, as it has been said that in steam-carriages the springs have been springs only in name. The boiler is not tubular, but the proprietor declines stating its peculiar nature until he has secured a patent. One circumstance stated by him is remarkable. He positively declares that though his steam-carriage has worked, on an average, four or five days a-week since last June, it has not cost him a penny for repairs, excepting the charge for one new set of fire bars —[London Times.]

Railroads.—The long projected railway from Birmingham to London is again to be brought before the legislature. It is expected that the railway will be continued from Birmingham to Liverpool, and from thence to Edinburgh. The Southampton to London, by Fauxhall, Wandsworth, and Kingston, across Ditton-Marsh and Walton-common, to Weybridge, thence south of Basingstoke Canal to Trimley, where it will cross and proceed to Winchester, and through Stoneham to Southampton. The whole distance of the line will be rather less than seventy-seven miles. The railway from London to Brighton projectors intend to apply for a bill. Every preparation has been made to commence the railway from London to Greenwich. It will be continued to Woolwich, thence to Chatham and Dover.—The French have it in contemplation to make a railway from Calais to Paris.—[Lon. paper.]

Fig. 1.

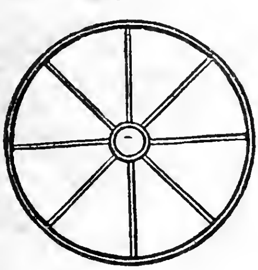


Fig. 5.

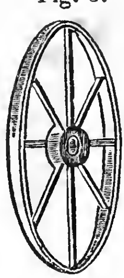


Fig. 3.

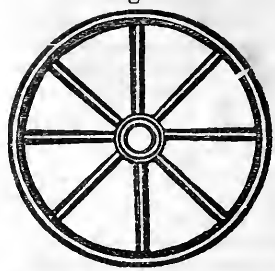


Fig. 2.

Fig. 4.

English Patents.—*Specification of the patent granted to George Forrester, Civil Engineer, for certain improvements in Wheels for Carriages and Machinery, which improvements are applicable to other purposes. Dated September* 5, 1831.

To all to whom these presents shall come, &c. &c.—Now know ye, that in compliance with the said proviso, I, the said George Forrester, do hereby declare, that the nature of my said invention, and the manner in which the same is performed, are described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, (that is to say)—

My invention consists in a peculiar mode of combining cast iron with wrought or malleable iron in the construction of wheels of all descriptions, (excepting those of such small dimensions as the wheels of clocks and watches,) and in the application of the same principle of construction to the framing for steam engines and machinery, the arches of bridges, and in every case in which cast iron framing may be employed, and wherein great strength and lightness are desiderata.

My mode of accomplishing the aforesaid combination is as follows:—I make a skeleton, or light frame, of wrought iron, or steel, of the shape of the article required, but of considerably less dimensions; this skeleton I render bright, free from oxide, and clean, by any convenient operation, such as grinding, scouring, and filing, to adapt it to receive a coating of lead, or bismuth, or tin, or zinc, or any mixture of those metals, such coating being performed by similar means to that used in the well known process called "tinning." The article to be cast having been moulded in sand (or loam) in the common way, the skeleton, coated as before mentioned, is carefully laid in the middle of the respective parts of the mould, projecting pieces being attached to the skeleton to keep it in its proper place; the mould is now closed, and the cavities formed by the pattern are to be filled up with fluid cast iron which completes the operation.

By this mode of embodying or enveloping wrought iron or steel skeletons of the shape of the intended article, with cast iron, the latter material is not injured in its tenacity, while the former is considerably improved, and thus the important qualities of toughness and infrangibility are introduced into forms more perfect

and structures more solid than can be obtained in wrought iron alone. To prevent misconception, I annex a drawing illustrative of the construction of one of the leading objects of my invention, that of wheels for railway carriages, and which will also serve satisfactorily to explain the mode of applying the principle of construction to the purposes before named.

Description of the Drawing.—Fig. 1 exhibits a side view of the wrought iron or skeleton framing before described.

Fig. 2 shows an edge or outside view of the peripheral ring of the skeleton, showing its proportional breadth, and containing a number of holes made throughout its circumference for the purpose of allowing the fluid iron, in casting, to flow through the holes, and fix itself in a solid mass around the skeleton.

Fig. 3 represents a section of the wheel in the line of its motion, the blank line showing the skeleton embodied in the cast iron.

Fig. 4 shows a section of the wheel through its diameter, including two of the spokes; and Fig. 5 affords a perspective view of the entire wheel.—[Rep. Pat. Inv.]

Salt.—A farmer in Missouri asks through the newspapers for the reason why, when the duty on salt has been so much reduced, the price is so much increased? Is it not a fact that high duties often reduce prices, and *vice versa?* Certainly, so far as high or low duties diminish or increase production or consumption. Instance molasses and coffee. Very soon after a duty of ten cents per gallon was laid on molasses, by the tariff of 1828, its selling price declined in the West Indies and the United States—for the distilleries were stopped: and coffee, for a year or two past, though the duty had been reduced from five cents to one cent per pound, has been dearer than it was in several preceding years. Duties may, or may not, enhance the price of articles, for price depends on supply and demand. The advanced price of salt, as above suggested, may be caused by a discouragement of the makers of it in the west, in consequence of a reduction of duty on the imported article. A brisk competition among producers is the surest means of cheapening commodities to consumers. But it is hard to make the people believe that duties on imports are not always taxes imposed on them; and yet a greater or more injurious mistake can hardly be committed on the subject of taxation. Price, besides, is relative. Tens of thousands of persons were starving in Ireland when potatoes were selling for less than one-third of a cent per pound—at which time they were worth in the cities of the United States one and a half cents per pound; but the first had not the means to purchase potatoes, and hence they were dear in Ireland, though cheap in the United States.—[Niles' Reg.]

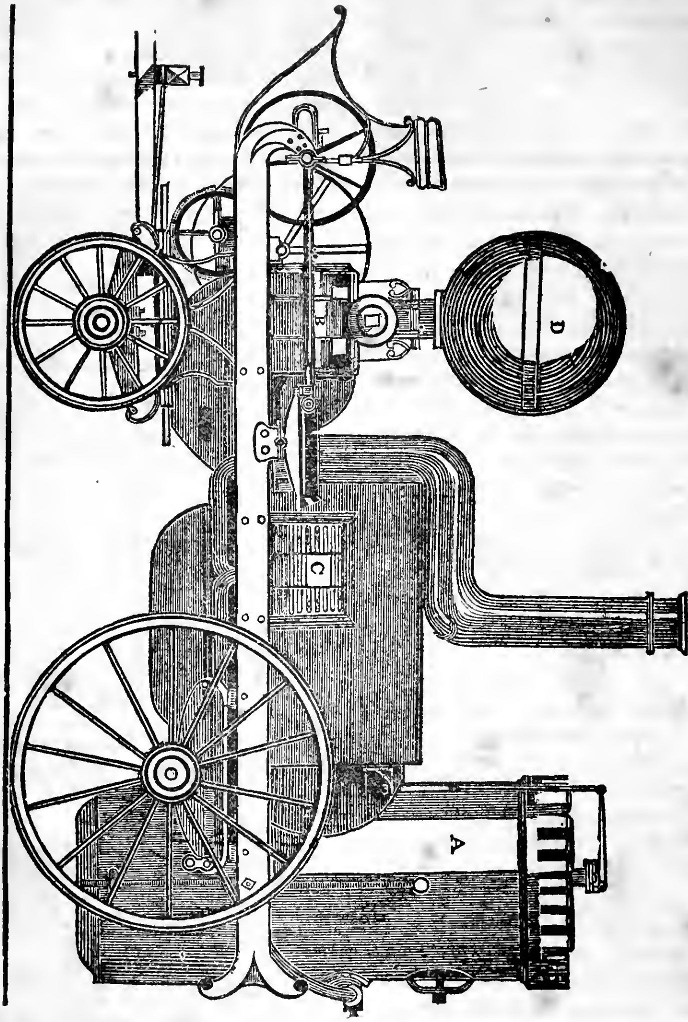
We learn that subscriptions were taken recently for a new joint stock company, to establish a line of steam-carriages between this town and Boston, over the turnpike. The plan is said to be to run a carriage every hour in the day, each way; and if the project is successful, the line will be continued to Newburyport.—[Salem Gazette, Mass.]

The Steam Fire Engine "Comet."—We give on the following page an engraving of a new steam fire engine, which has been built by Mr. Braithwaite for the King of Prussia, and has been named the "Comet," (in honor we presume of the portentous stranger whose near approach is,

———with fear of change,
Perplexing monarchs.)

It is intended to be exclusively employed for the protection of the public buildings of Berlin, and will in a day or two take its departure for that capital. On Monday last we were present at a public trial of its capabilities at Mr. Braithwaite's Wharf, on the Paddington Canal, and we now proceed to report the results of which we were eye-witnesses.

But first, a word or two by way of description: the engine, it will be seen, bears a general resemblance to the one of which we gave an account of in our 340th number, and which has been repeatedly employed with so much effect at fires in this metropolis. A, the boiler, is on the same plan as that of the Novelty, with this exception, that the combustion is promoted by means of an exhauster, F, instead of a bellows; the flue is in two lengths, and the greatest diameter 5 inches. The steam cylinder, C, is 12 inches in diameter, with a 14 inch stroke. The water cylinders, of which one only (B) is seen in the engraving, are ten and a half inches in diameter, with also a fourteen inch stroke. The steam from the eduction pipe is conveyed through two coils of tubing laid in the water tank, and imparts a considerable degree of heat to the water before it is trans-



ferred to the boiler. D is the air vessel, E the furnace grating. The feed pump, (not seen in the engraving,) is equal to the supply of from 20 to 25 cubic feet of water per hour.

The steam having been got up, (in 20 minutes as we were informed,) and the pressure in the boiler being at 70 lbs. the square inch, the engine was set to work with a single pipe applied, of $1\frac{1}{4}$ inch in diameter. The height to which the water was ejected could not be less than from 115 to 120 feet. The number of strokes per minute was eighteen, which gives for the quantity of water thrown 1 ton 7 cwt. 13 lbs. per minute. For,

The water cylinder being $10\frac{1}{2}$ in diameter, the area of the water piston must be 86·6 square inches;

And a 14 inch stroke of the engine gives for the length of the stroke in the water cylinder 56 inches;

Therefore, $86{\cdot}6 \times 56 = 4849{\cdot}6$ cubic inches of water each stroke $= 2{\cdot}8$ cubic feet. Deduct for back water through the valves, 1, leaves for the effectual result 2·7 cubic feet;

And multiplying 2·7 by 18, the number of strokes per minute, we have 48·6 cubic feet per minute $=$ 3037 lbs. $=$ 1 ton 7 cwt. 13 lbs.

Two pipes were afterwards substituted, of 7-8 inch in diameter; then four of 5-8 inch in diameter; and the effect produced in each instance was as nearly as possible equivalent to that obtained by the 1¼ inch jet.

The average working power of the engine may be therefore stated at between 80 and 90 tons of water ejected per hour.

The consumption of coke per hour is about three bushels.

The sum agreed to be paid for the Comet is £1200; but we should imagine that this can scarcely be a remunerating price for an engine of such magnitude and power, and finished in a style of workmanship which called forth the most unqualified encomiums from the numerous engineers and other scientific persons present at the exhibition of Monday last.—[London Mechanics' Mag.]

Docks, Edifices, and Commerce of Liverpool. By B. P. [From the New-York Farmer, and American Gardener's Magazine.]

As Liverpool is generally the first landing place of Americans crossing the Atlantic for business or pleasure, perhaps some little notice of it will be interesting to your readers. The spacious docks into which ships are admitted on their arrival always excite the wonder of an American—showing in a most astonishing degree the power of science and art, in overcoming what would, but a few centuries since, have been considered insurmountable obstacles. They are of three kinds: the principal are the west docks, which chiefly receive the ships in the foreign trade, which have large and heavy cargoes to receive and discharge. In these the ships are afloat at all times of the tide, the water being retained by the dock gates. The next one is the dry dock, or basins, as they are called, because they are left dry when the tide is out: these generally receive the vessels which are employed coastwise. The others are the graving docks, which admit or exclude the water at pleasure, and in which the ships are laid dry for the purpose of repairs. Prince's Dock is where the American ships lie, and is exceeded in size by the Queen's Dock only. It was commenced in 1815, and completed in 1821. It is 500 yards long, and 106 broad, and covers an area, including its two locks, of 57,129 yards. It has gates, each of which is 42 feet wide and 34 deep, with locks at each end. The locks are constructed so as to admit vessels in and out at half tide. This dock is built of uncommon strength, and according to the most approved principles of naval architecture. It is inclosed by gates at convenient distances. At the north end is a dwelling house, with suitable offices, for the Dock Master. The quays are spacious, on which are erected sheds to preserve merchandise from the effects of rainy weather, of which they have much at Liverpool. Spacious as the docks are, they are still considered as too limited for the increased commerce of the port. As a sample of the increase of shipping and duties at Liverpool, I annex the following:

	Vessels entered.	Amount of Duties.		
In 1760	1,245	£2,330	3	7
1800	5,746	24,379	13	6
1810	6,729	65,782	1	0
1820	7,276	117,962	14	6
1830	11,224	151,329	17	10

The population of Liverpool is estimated at about 165,000, showing an increase in 10 years of upwards of 46,000. The suburbs are very populous, and contain at least 40,000 inhabitants. Liverpool contains no valued remains of ancient, barbarous, or classic architecture; no antique inscriptions, in characters half obliterated by time; nor any of the more portable which adorn the antiquarian cabinet, rendered sacred by the rust of ages. The attention is not arrested by sudden and frequent revolutions, nor the imagination seized with tales of

"Deeds heroic, sieges rais'd, or battles won."

Its history is the history of the silent but powerful operations of industry, and its topography stands an honorable monument of ardent activity, and well-directed enterprize.

The public structures devoted to religion in the town of Liverpool are numerous, and their size and the high style of elegance in which many of them are finished, render them superior to most in the kingdom. They are among the first objects that deserve the attention of the stranger. St. Nicholas, or the old church, is said to be the oldest ecclesiastical foundation in the town, and although it would be difficult to trace its primary history, a licence to bury in the cemetery attached was granted in 1361, by the Bishop of Litchfield, who then presided over this diocese. Its situation is near the docks. In the churchyard was formerly a statue of St. Nicholas, who, in the papal calender, is made the tutelar deity of the mariner, to whom the sailors presented an offering on

going to sea, to obtain from the saint a prosperous voyage and safe return.

The interior of the church presents few venerable remains of ancient dignity, most of them having been displaced to make room for modern decorations. The font is of white marble, the cover or cap of which is a curious composition in the style of ancient crosses. An ancient manuscript thus describes one of the chantries: "The chantry of the high altar of the foundation of Henry, Duke of Lancaster, to celebrate therefor the souls of himself and his ancestors;" which is observed accordingly, and the grant is for ever. There are about 30 churches, and from 12 to 20 what are termed chapels, being of other denominations than those used by the established religion. The church of the school for the blind is well worthy of attention. The objects in erecting this beautiful church were, first, to accommodate the blind pupils with a place of divine worship near the school; the other, that the superior singing and music made by the pupils might attract those having a taste for music, and that would contribute to the funds for their support. One half of the pews are reserved for strangers, who, I believe, are universally gratified, and always contribute their mite for an object so deserving.

A very excellent specimen of stained glass may be seen in the altar window. The subject is the Ascension; the reflection of the light through it is exceedingly beautiful. The architect copied for the portico at the west end, the portico of the Temple of Jupiter Panhellenius, in the isle of Ægina, which is really a most beautiful design.

B. P.

New-York, January, 1833.

Foot Railroads, No. II. By PUBLICOLA. From the American Railroad Journal and Advocate of Internal Improvements.]

In No. 23, Scientific Tracts, it is stated that a horse, at five miles an hour, usually exerts the force necessary to raise 45 lbs. over a pulley, and draws on a level railroad about four tons. At two miles an hour, he usually exerts a force necessary to raise 112 pounds, and draws on a level railroad about 10 tons. It is computed that a man can draw on a horizontal line about one-seventh the load a horse can draw; and therefore, he could draw at two miles an hour 29 cwt., or more than two horses could draw on a common road at four miles an hour,—and more than a yoke of oxen could draw at two miles an hour. One man on a level railroad could move, at two miles an hour, more than a yoke of oxen could move at the same rate on a level road. But, on a railroad, there will be some portions where the road will not be perfectly level. If, in these portions, there is a rise of one foot in eighty, or sixty-six feet in a mile, then, to overcome this ascent, there must be exerted a force sufficient to raise over a pulley one-eightieth of the load, in addition to the force necessary to move it forward on a level. To move it forward on a level, he must exert a force sufficient to raise 16 lbs. over a pulley; and, in addition to this, to draw 29 cwt. up an ascent of one foot in eighty, he must use a force sufficient to raise 40 lbs. over a pulley. A man, therefore, who with a cord over a pulley can raise up 56 lbs. can move a load of 29 cwt. up a railroad ascending one foot in eighty, or sixty-six feet in a mile; and, on a level, he can move such load as easily as he can raise 16 lbs over a pulley. This shows the vast advantages of a railroad over a common road. The inquiry may now be made why a narrow, and therefore a very cheap, railroad may not be made for the use of men? If they can move forward on such a road only one ton, or even half a ton, they could easily do on one such road all the transportation that is needed on most of the routes leading to our principal market towns. Let those who have heavy articles to transport, and those who regard the welfare of the community, inquire into this matter.

PUBLICOLA.

New-York, January, 1833.

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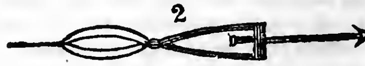


Improvements in Mr. Murray's Plan for Instantaneous Communication with Stranded Vessels. [From the London Mechanics' Magazine.]

In No. 441, we have an account of Mr. Murray's excellent invention for saving from shipwreck, abstracted from a pamphlet published by that ingenious and very philanthropic gentleman. We have now before us a "Supplement" to that pamphlet, in which Mr. Murray describes some material improvements which he has since effected. In the

experiments which we last recorded, Mr. Murray had only got the length of being able to project his safety line from a common musket; but the purpose of the present "Supplement" is to announce that "in a thousand instances a *pistol* with an arrow and its line will afford sufficient means to convey a rope and establish a medium of escape from the wreck to the shore."

The improvements made consist in a better construction of the arrows, and will be readily understood from a comparison of the prefixed sketches with that given in No. 441. The arrows, 1 and 2, are made of solid iron, and the spindle is polished, to allow the sliding appendage and the recoil-spring to fly backwards with as little resistance as possible. The arrow is of metal, because it is found to project much further than one of wood. The recoil-spring is of steel, which answers better than the cork or caoutchouc originally proposed. The snapcord is intended to meet the first sudden jerk, and provide a double curb to the violent impetus of the projected line, so that a charge of gunpowder double or treble what is usual may be employed. The arrow, No. 1, weighs, together with its appendages, $4\frac{3}{4}$ ounces, is one foot long, and $\frac{7}{8}$ inch in circumference. The arrow, No. 2, with its adjustments, $5\frac{3}{4}$ ounces, is $10\frac{1}{2}$ inches long, and 1 inch in circumference.

With the arrow, No. 1, Mr. Murray made the following experiments, making use of a pistol $8\frac{1}{2}$ inches long, and $\frac{11}{16}$ inch diameter in the bore, and a cord 110 yards long, weighing 11 ounces:

"First experiment; at an angle of 40 degrees, with 23 grains of gunpowder, the arrow carried the line 71 yards.

"Second experiment; at an angle of 30 degrees, with 34 grains of gunpowder, the line was carried 72 yards.

"Third experiment; at an angle of 45 degrees, with 46 grains of gunpowder, the line was carried 85 yards.

"Fourth experiment; at the same angle, and with a similar charge, the line was carried 83 yards.

"Fifth experiment; at the same angle and with a similar charge, the line was carried 84 yards.

"In no instance did the cord break."

With the arrow, No. 2, the following results were obtained, but it does not clearly appear from Mr. M.'s statement, whether with a musket or a pistol:

"At an angle of 45 degrees, with 46 grains of gunpowder, and the wadding hard rammed down, the arrow carried with it 110 yards of line.

"The cord, and all the adjustments as in the other experiments, remained completely entire, and were not, in the most remote degree, injured. The recoil, in the last case, however, was rather too violent, from the additional weight of the arrow, and the degree to which the wadding had been rammed down: a circumstance which it seems necessary to state.

"The gun, which has been manufactured by Mr. Pritchard, of Birmingham, under my directions, can discharge eight drachms of gunpowder with great ease.

"The arrow, in this case, was formed of brass, with a sliding ring embracing the rod, and having the line attached to a loop, the whole weighing $6\frac{1}{2}$ ounces, carried a plaited hemp cord, double the thickness of a garden line, more than sufficient to pull a considerable rope on board, from the shore, and adequate to form the requisite line of communication with the vessel. This arrow carried the line 57 yards, with only one drachm of gunpowder.

"In the second experiment the arrow carried the line 112 yards, with 2^{2} drachms of gunpowder. These last experiments were made at Birmingham, and in no instance whatever did the line break."

Mr. Murray adds the following valuable practical remarks:

"I. *The Arrow.*—The material of the arrow should be iron, and the more tough the better; perhaps old horse shoes, welded longitudinally and in separate pieces, will be the best, and finally wrought in the manner of the English twisted gun barrels, or the French '*canons a ruban*'—or ribbon barrels, which approach sufficiently near to them.

"II. *Gunpowder.*—This differs materially in power and propelling force. It has, I believe, been estimated as high in some cases as equivalent to a thousand atmospheres. Col. Mark Wilks informed me, as the result of a series of experiments made by him at St. Helena, that semi-burnt charcoal very materially increased the power of gunpowder. Willow, hazel, and dogwood, are the woods which supply charcoal for powder mills; and the last, if I am correctly informed, is preferable at Battle for the manufacture of the finest kinds. The smaller grained is inflamed more rapidly than the other, and it should seem, from experiments made

in reference to the question, that the inflammation is also more complete. A little lycopodium powder mixed with the priming, while it would facilitate the ignition, would tend very materially to protect it from wet, and consequently render it much more certain.

"III. *Wadding.*—This may be formed by a slice of thin cork, or of an old hat or card punched out, or of soft brown paper, which last will seldom fall to the ground nearer than a distance of 20 or 30 feet from the muzzle of the piece. Some attention must be paid to this circumstance, since, if formed of too pliant materials, such as cotton, &c., it will not be of sufficient consistency for the purpose; it will, therefore, lose in force, and the shot will not be carried so far. On the other hand, if the wadding be too stiff and inflexible, or rammed down too firmly, the shot will spread, and the piece will recoil considerably more. A medium in both, therefore, will be found essential.

"IV. *Recoil.*—This arises from the retrograde motion of the piece, and is dependent on a well known law in mechanics, namely, that action and re-action are alike. Excess in the recoil may be generally traced to inequality in bore, but it is taken for granted that the piece has been submitted to the usual proof before it leaves the hands of the manufacturer. The weight of the piece being the same, the recoil will be in the ratio of the quantity of gunpowder and the weight of the ball, or other projectile. The recoil will also increase with the number of times the piece is fired, which would seem to connect the question with the evolution of moisture or expansion by produced temperature; it is also, as has been stated, attendant on the wadding being rammed down too firmly. The butt end of the gun must be held closely and firmly to the shoulder.

"V. *Bursting of the Barrel.*—This is a very rare event, and easily prevented. Sometimes, indeed, it is the fault of the workman, and proceeds from a defect in welding, but the reputation of a respectable manufacturer being compromised, very little danger need be apprehended. The only other causes likely to occur in this question is the danger of an over-charge, which a correct measure accompanying the powder flask or canister will most effectually prevent—the gun manufactured by Mr. Pritchard will bear 8 drachms of gunpowder, and not more than $3\frac{1}{2}$ drachms can ever be required, leaving a reversion of $4\frac{1}{2}$ drachms of powder. There therefore remains only another caution, and that is, the end of the arrow must be brought in complete contact with the wadding, which will be effectually secured by the angular elevation of 45 degrees—an elevation which secures the greatest range; the general cause of bursting in ordinary cases is to be attributed to the circumstance of the ball not being rammed home, and a space left between it and the charge of gunpowder.

"So simple an apparatus might be disposed of in a small compass, and when put up in a convenient case, kept on board vessels; it might thus be made available in a few seconds, in the hour of danger. The impulsion of the arrow would be materially assisted by the gale blowing towards a lee-shore, and it would have, in relation to the line of direction and its successful receipt on shore, the combined advantages of an extensive segment of a circle over a merely central point."

Not the least important feature of Mr. Murray's plan is its great cheapness, compared with every other which has been proposed:

"The expense required for the establishment of a few stations of Captain Manby's apparatus will supply some thousands of these, (blunderbusses, muskets or pistols)—in fact, suffice for the British isles." Mr. M. states, that a "gun with six arrows, two lines, each 200 yards long, two tin cans to hold the lines, a powder-measure, a supply of wadding, &c., will cost (only) from £4 to £5;" and "the smallest gun, (query, the pistol?) with the apparatus complete, much less."

We are glad to perceive that the "National Institution for Saving from Shipwreck" have determined on forthwith introducing Mr. Murray's invention on the dangerous coast of Sussex; nor can we anticipate less than its speedy adoption along all our shores. Mr. M. adverts with great modesty to the trouble and expense which he has been at to bring the invention to its present state of perfection, but rather by way of apology for not doing more in its behalf, than with a view to eliciting any public reward. We trust, however, that a great and generous nation will not on that account be the less disposed to mark, in some suitable manner, its sense of the valuable present he has made to it. If Captain Manby was thought well deserving of £3,250 for his imperfect apparatus, it cannot be that the inventor of one in every respect superior to it should be suffered to go wholly unrewarded.

Importance of the Silk Culture—Aid from the General Government required. By A. W.

To the Editor of the New-York Farmer.

The Chinese, knowing the great value of the silk manufacture, closely guarded the secret of its management by the most rigid penal enactments, by which means they were enabled for many centuries to keep the silk worm from spreading over the world, consequently monopolized the whole business, which was a source of much wealth to their empire.

Many fruitless attempts were made by crowned heads to obtain the worms, and to learn the mode of their management, but for a long time without success.

The prospect of great reward at length put a few eggs of the silk worm in possession of the emperor Justinian. From this small beginning all the silk worms in Western Asia, Europe, and America, have been produced. England, Holland, Germany, Russia and Sweden, are fully aware of the importance of the Silk business. France, more than any other nation in Europe, is deriving her power and greatest resources from the culture and manufacture of silk.

Our Treasury returns, for several years past, show that the silk imported and consumed in the States is more in amount than the bread stuff exported. Silk may be successfully and advantageously cultivated in every state in the Union. Experiments have shown American silk to be superior in color and texture to the silk of any nation. Other agricultural labor will not be lessened by such culture. The condition of the poor will be much improved; the young and infirm make good silk culturists.

The climate of England is too damp and cold to propagate the silk worm. America may yet reap great profit on raw silk as an article of export.

Jay made no mention of cotton as an article of American production, in his treaty with England, 1704. The present year's crop of cotton is worth about thirty millions of dollars. Many of our citizens, who about 38 years ago planted cotton seed, may be living witnesses of the fact, that cotton is the first staple in the states. A large portion of those who are now planting the mulberry seed may live to see raw silk the second grand staple of our country. The state of Connecticut has taken the lead in the growth and manufacture of silk. Many of her citizens are entitled to great credit for their persevering and patriotic efforts.

Mansfield has been engaged more or less in the raising of silk ever since 1760, and the quantity gradually increasing. Windham and Tolland counties have produced for the last year raw silk sufficient to employ fifty-five looms, which would manufacture about 30,000 yards per year, say vestings and other broad goods.

Considerable quantities of silk goods have been produced by the enterprizing perseverance of Mr. Rapp, of Economy, in Pennsylvania. *Superior specimens of what might be accomplished by a judicious national fostering was exhibited last winter at Washington, by the venerable and learned Mr. Duponceau.* Many other parts of the Union have produced specimens of silk stuffs and sewing silk; the latter article is found the most profitable, yet, in manufacturing this, a great drawback to profit is experienced from not systematically understanding the art of filature, or reeling the silk from the cocoon. In other countries, where sewing silk is manufactured, the tow of the silk is worked in; but we are obliged to make use of the best part of the fibre. Our sewing silk is stronger than the Italian, but in consequence of our defective reeling it is very wasteful, difficult to keep from tangling, &c. The finishing of piece goods suffers from the same cause.

It must be obvious that something is materially wrong in the silk operations of our people, or the manufacturing of it would, ere this, be entered into much more generally.

The culture of silk was attempted in Virginia a century and a half before cotton was brought into notice. The growth and manufacture of cotton has progressed with astonishing rapidity—the value of our cotton manufactories is immense. It is now only 25 or 30 years since it was thought the ingenuity of our people would not be equal to manufacture as good and as cheap goods as the once celebrated India Baftas and Hummums.* A very short period of experiment drove these very inferior trash from our shores. The bare mention of such fabrics being once in so general use in our country causes almost as much risibility as the fact of importing building brick from Holland. Our cotton goods now find their way to the Indies; our bricks are equal to any in the world; and, with a little national protection, we will soon cease importing silk, and have raw silk to spare for a profitable export.

* The home consumption of raw cotton has increased 600 per cent. within the last 16 years, while that of Great Britain has only increased 220 per cent. in 21 years.

Many of the states, by their public acts, have shown their very decided opinion of the immense importance of the culture of silk, as a great and commanding national object; yet still this grand object lingers.

The chairman of our Congress committee on Agriculture, 1832, speaking of the manufacture of silk, remarks, "On an experiment untried in this country, and requiring considerable capital, a reliance on individual enterprize would be at least problematical; and it is not to be expected that the several states will ever be found to act in concert, so as to attain the result which a national operation is calculated to procure."

If the manufacture of silk should ever be undertaken upon an extensive scale in the United States, Congress must give us a National School, to teach the whole process of silk work, but more particularly the important art of filature.

The eight millions of dollars sent annually out of the country for silks, in its various forms, can be saved, and it is as well to begin now as wait another century.

A. W.

Lansingburgh, Jan. 1, 1833.

Ericsson's Steam Engine and Water-Mill.—Perhaps the most interesting problem in mechanical science is how to simplify the steam engine, so that its bulk and weight, which are at present somewhat enormous, may be reduced within more convenient limits without any corresponding loss of power. Owing to a variety of causes, all well ascertained by long practice, a reciprocating engine cannot be made to work to advantage at more than a moderate rate of speed; it becomes therefore necessary to expose the piston to a great force, (for that force multiplied by the speed constitutes the power,) and, as a necessary consequence, all the parts that have to communicate this great force, as well as the frame work that carries those various moving parts, must be made strong, in proportion. Hence it follows as a general rule, that the bulk and weight of any engine of a given power, worked by steam of given force, must depend on the speed of the piston, that is, the speed of that surface which the steam is made to propel. This truth forms the basis of the construction of the very remarkable engine which we have now to bring under the notice of our readers.

In the patent which Mr. Ericsson has taken out for this invention, he designates it as "an improved engine for communicating power for mechanical purposes;" and this generality was, perhaps, necessary, since, though it promises to be of most importance in connection with steam, it may be worked by any other gaseous or fluid power, as air, water, &c. The specification describes it more particularly as consisting of a "circular chamber, in which a cone is made to revolve on a shaft or axis by means of leaves or wings, alternately exposed to the pressure of steam; these wings or leaves being made to work through slits or openings of a circular plane, which revolves obliquely to, and is thereby kept in contact with, the side of the cone." But when the reader has read this description of the engine, we are afraid he will not be much the wiser for it; indeed, we never before met with an engine of which it was so difficult to convey, *in words*, a clear and distinct notion, and which was at the same time so little complex in its construction. We shall, therefore, be obliged to depend more than usual on the assistance of our engraver, to make the following description plain to our readers.

Fig. 1 represents a longitudinal section of the engine, the circular chamber being supposed to be cut through the centre line. AA is a circular chamber made in two parts, joined at *a a*, and fixed to a frame B B; this frame also supports the axis or main shaft C, to which is fixed the cone D. E E are two wings or leaves fixed to the cone; and *e* is a metallic segment, fitted into a groove made in the curved edge of the leaf, and pressed towards the chamber by springs, in order to prevent the escape of steam. F is a circular plane, revolving on a shaft or pivot G, and supported by the main shaft (as shown in fig. 4.) The oblique position of this circular plane, it will be seen, is so adjusted that its surface shall be parallel to, and in contact with, the side of the cone. H is a metallic ring fitted into a groove round the cone, and divided into segments, which are pressed towards the chamber by springs, to answer the purpose of packing. I is a metallic ring for the same purpose, fitted round the circular plane. K is a cylindrical brass for the pivot G to work against *e*, regulated by a key *k*. L is a conical brass guide, kept in its place by a set-screw *l*. M is a screw-pin for giving oil to the pivot. N N are conical brasses for the main-shaft to work in, and kept in their places by set-screws *n n*. *o o* are screw-bolts for securing the engine frame. P is a pinion or small

Fig. 1.

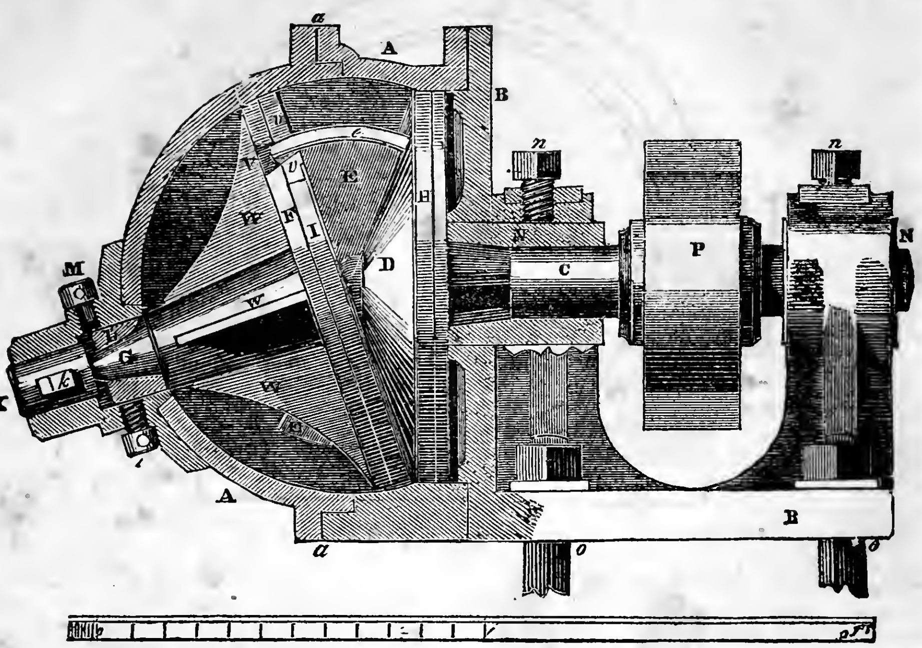


Fig. 2.

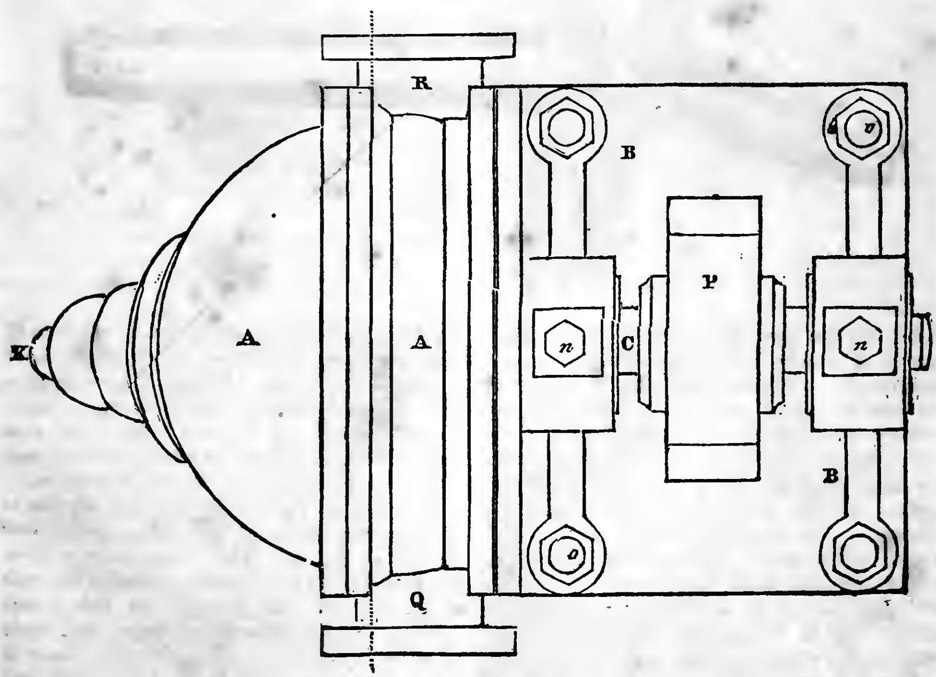


Fig. 3.

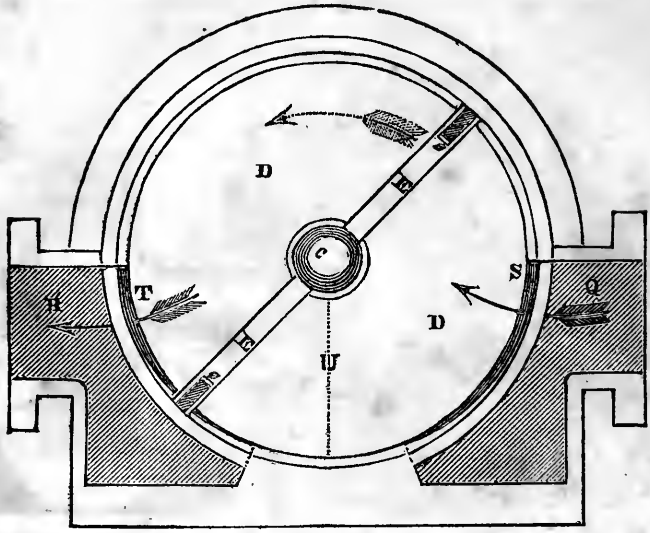
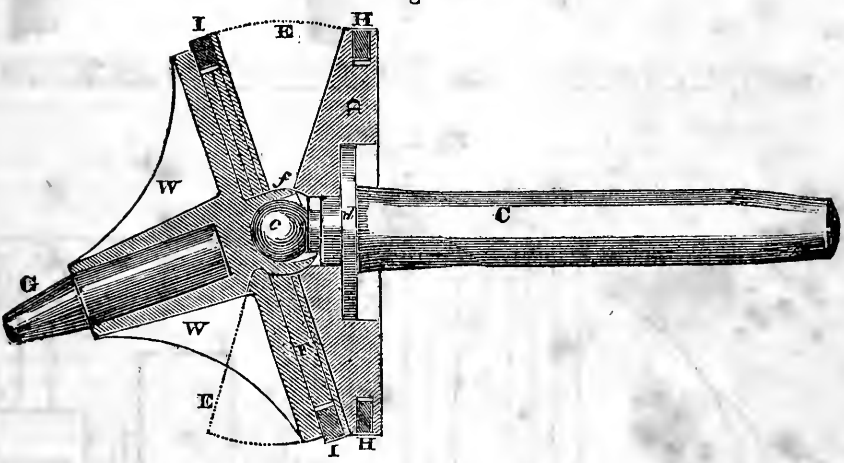


Fig. 4.



wheel, for the purpose of communicating the power of the engine to machinery which may require a different speed. V is one of the slits or openings, in the obliquely revolving circular plane, through which the leaves work; this slit is of equal length with the leaf, and widening outwards from the surface of the plane, to accommodate the change of the angular position of the leaf, which takes place during each revolution. *v v* are metallic rods, kept tight against the leaf by springs, to prevent the escape of steam. W W W are thin flat arms for supporting the circular plane.

Fig. 2 represents the plan or top view of the engine, showing the exterior of the circular chamber, the frame work, main shaft pinion, &c. (It may be as well here to state that similar letters are used to denote similar parts in all the figures.) Q is the pipe through which the steam enters the engine, and R the pipe through which it escapes.

Fig. 3 is an end view or cross section of the engine, taken through the dotted line marked in fig. 2. The steam passes from the pipe Q into the circular chamber through an opening S, cut through its side; this opening is of a triangular shape, and made as wide at the top as the circular plane is there distant from the base of the cone, and

gradually tapering off downwards. T is the opening through which the steam escapes, and in every respect similar in construction. The dotted line U shows where the cone and the circular plane come in contact. *e e* are the metallic segments already described.

Fig. 4 is a detached view of the cone in the circular plane, representing a section through their centres. It will only be necessary to observe that *d* is a collar on the main shaft, by which the cone is fixed thereto; that *c* is a socket-ball, working in the socket *f* of the circular plane; and that the dotted lines E E show the precise shape of the leaves or wings fixed to the cone.

Having thus described the nature and construction of Mr. Ericsson's engine, we shall now proceed to explain the manner in which it is set to work. Steam being admitted into the pipe Q, (see fig. 3,) it passes through the opening S into the circular chamber, and being there prevented from passing the line U, where the cone and plane come in contact, it presses against the upper leaf, which, together with the cone, then revolves in the direction of the dotted arrow. Now, as soon as the said leaf gets below the top of the opening T, the steam that has been acting escapes through that opening into the pipe R, and thence into the atmosphere or into a condenser. The opposite leaf then operates in a similar manner, and so on as long as steam is admitted.

Many as have been the engines contrived for the production of rotary motion, we recollect none in which that result has been obtained by such a perfect harmony of operation among the different parts. Not only the general action of this engine, but the action of every part of it, is rotary. The consequence is that it is wholly free from those serious drawbacks which make the attainment of a very quick motion, by means of a reciprocating engine, a matter of so much practical difficulty. A vast increase of power is obtained, while the bulk and weight of the materials employed for the purpose are reduced beyond all former example. We shall endeavor to make this clearer by a few calculations.

The engine represented by the drawings (made to $2\frac{1}{2}$ inch scale) presents to the action of the steam 12 square inches within the leaf, and is in a vertical position; but that being the maximum of surface exposed, a mean must be taken, which by the assistance of fluxions will be found to be ten square inches within a fraction.

By referring to the scale, it will be seen that the globular chamber of this engine is 13 inches in diameter. An engine of three times the size, that is, with a chamber of 39 inches in diameter, would, therefore, expose 90 square inches to the action of the steam; and the average distance performed by the leaf would be 4.37 feet for each revolution, and if the engine made 180 revolutions in the minute, 1,323 feet would be the distance passed in that time. If, now, steam of 45 lbs. pressure to the square inch were used, 4,050 lbs. would be the constant force in operation, which multiplied by 1,323 shows that 5,358,150 pounds would be raised one foot high per minute; and this sum divided by the established number, 33,000, gives for the general result 162 horses' power. Now, if we deduct one quarter for friction, &c., which, considering the harmonious action of the engine, is amply sufficient, the available power will be 120 horses!

That so great a power should be produced by a globular vessel of only three feet three inches diameter, is a result so extraordinary that the attention is naturally and anxiously drawn towards any probabilities by which it may be defeated. The probability of the action becoming affected by leakages first presses itself on our consideration. On this head it may suffice to observe, that as none f the packings require any other play than to be moved gradually against their respective surfaces as they wear away, all that is required to insure tightness will be good workmanship. The next contingency which suggests itself is the ordinary one, of liability to derangement. On this score, however, there is but little to be feared, for the engine is of so few parts, and the mutual action and reaction of these parts is so simple and natural, that unless wantonly injured or obstructed, it can scarcely go wrong. We apprehend that the only real danger to be guarded against is the heat which may be generated by the rubbing parts, when the engine is put to its speed; between the bearings and gudgeons in particular, as they will have to withstand a great force. Experience can on this point be the only guide to a correct conclusion; but we incline to think, that as no inconvenience is found in cotton mills by giving shafts of a large size, and communicating great power, a velocity of 180 revolutions per minute, any deduction to be made on this account from the utility of the engine will be but trifling. As to the packing rings, the

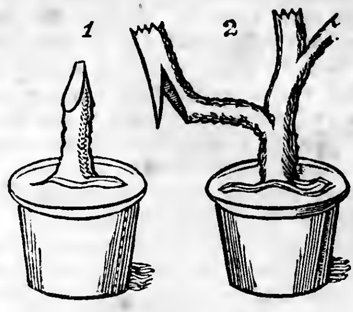
pressure on them will be but slight; indeed, their centrifugal force will be nearly sufficient to give them always an outward bias; the danger of their heating must, therefore, be extremely small.

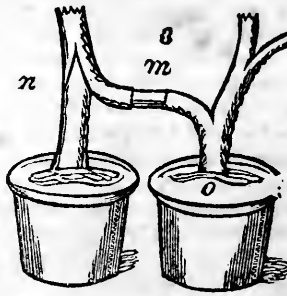
It may not be amiss to observe, that the principle of the engine is such that the steam may be admitted from either side with equal effect. The motion can, therefore, be reversed, by merely reversing the inlets and outlets of the steam by means of a common slide valve or four-way cock—a feature of this engine, which, to say nothing of its speed, must render it particularly applicable to all locomotive purposes.

The branch of steam service, however, in which this engine is likely to be adopted with greatest benefit, is the marine. In steam vessels, lightness, compactness, simplicity, are all properties of the utmost importance; and doubly so, when they can be obtained, as in this instance, without any sacrifice whatever of power.

When water is employed to work this engine, the operation will be precisely the same as in the case of steam; with this exception, that the packing rings may be dispensed with. The exception, however, is of a nature which shows that, as a hydraulic engi e, it will work even better than as a steam gine: of this, however, more hereafter. At present, we trust, we have said enough to satisfy our readers that the great space which we have devoted to this latest wonder of the mechanical world has been not unworthily occupied.—[London Mec. Mag.]

Woodworth's Patent Planing Machine.—A machine patented under this title is now in operation at the Furnace of Messrs. Stickney & Yerrington, in this village. It is designed for planing, tongueing, and grooving, floor-plank, ceiling, &c. It performs the labor in a workmanlike manner, and, what is unquestionably of much importance, brings the plank to an equal thickness and width. It will finish 18 feet of plank per minute, thus accomplishing an amount of labor equal to 35 men, during ordinary working hours, at an expense of about one-sixth the usual rate. It is far from being complicated in its construction, and is consequently not liable to get out of repair. Three knives are placed upon a cylinder, which revolves about 2,300 times per minute, by which the planing is effected, and tongueing and grooving by a process somewhat similar. Should the location of the machine make it necessary to propel it by steam power, the shavings would evidently furnish a large proportion of the necessary fuel. The invention seems to be one of practical utility, and cannot fail of being an important acquisition, wherever building to any considerable amount is in progress.—[Lockport Balance.]





New Method of Grafting by Approach.—Cut off the stock in the form of a wedge, as in fig. 1, and cut the graft upwards, half way through, for a sufficient length, as in fig. 2; then place the graft upon the stock, as in fig. 3, and bind it on with bass and clay as usual, taking off a circle of bark between the graft and the root, as in fig. 3, *m*, which will cause the sap to flow through the graft into the stock *n*, instead of its own root *o*. I recommend this method for grafting whenever the stock and the graft are of the same size, or very nearly so.—[Loudon's Magazine.]

[*From the Journal of Health.*]

Saccharine Aliment.—Dr. Prout considers the principal alimentary substances as reduceable to three great classes: the *Saccharine*, the *Oily*, and the *Albuminous*. The first of these, with certain exceptions, includes the substances in which, according to Gay-Lussac and Thenard, the oxygen and hydrogen are in the same proportion as they are in water. They are prin-

cipally derived from the vegetable kingdom, and being at the same time *alimentary*, Dr. Prout considers the terms *Saccharine principle* and *Vegetable aliment* as synonimous. The following, showing some of the results of Dr. Prout's experiments with various substances, great care being taken in every case to obtain these perfectly pure, will interest many of our readers, as showing the comparative nutritive properties of each.

SUGAR.	*Carbon.*	*Water.*
Pure Sugar Candy contains	42.85 pr. ct.	57.15
Impure Sugar Candy	41.15 to 42.15	58.50 to 57.50
East India Sugar Candy	41.90	58.10
English Refined Sugar	41.50 to 42.50	58.50 to 57.50
East India Refined Sugar	42.20	57.80
Maple Sugar	42.10	57.90
Beet-Root Sugar	42.10	57.90
East India moist Sugar	40.88	59.12
Sugar of Narbonne Honey	36.36	63.63
Sugar from Starch	36.20	63.80
STARCH.		
Fine wheat Starch	37.50	62.50
The same dried	42.80	57.20
Do. do. highly dried	44.	56.
Arrow Root	36.40	63.60
The same dried	42.80	57.20
Do. do. highly dried	44.40	55.60

PORT WINE.—The eulogists of pure Port Wine may be a little startled at the following official statement of the entire amount of wine exported from Oporto:

In 1818, the Factory wine exported from Oporto amounted to 32,843 pipes; of this quantity 32,465 were consumed by Great Britain and her dependencies, leaving 378 pipes to supply all the rest of the world with pure port wine.

In 1819, the total quantity exported was 19,502 pipes, of which nearly the whole was for the supply of Great Britain.

In 1820, the quantity exported was 23,740 pipes; almost the whole went to supply Great Britain.

In 1821, 24,641 pipes; nearly the whole to Great Britain.

In 1822, 27,758 pipes; of which 27,470 were consumed by the English, leaving 288 pipes for the supply of all other nations.

In 1823, 23,578 pipes were exported; of which 23,208 were for the supply of England, leaving 370 for other nations.

In 1824, 19,164 pipes were the number exported, the same proportion being consumed by Great Britain.

In 1825, 40,524 pipes exported, of which 40,277 were for the supply of Great Britain, and 247 for other nations.

In 1826, 18,604 pipes exported; 18,310 to Great Britain, and the remaining 314 to other countries.

CONSUMPTION OF FRENCH WINES BY FOREIGN NATIONS.—According to M. Paguirre, England uses less of the French wines than almost any other nation, if we except Sweden. In five years, 6,681 tons of French wines were admitted into England. Hamburg alone takes about eight times, and Holland upon an average twelve times as much.

CONSUMPTION OF WINE IN FRANCE.—In 1821 the quantity of French wines retailed in France, and of course chiefly consumed by the poorer classes, amounted to more than 335,000,000 gallons. In 1826, it exceeded 400,000,000 gallons. The quantity sold wholesale, and consequently consumed by the families of the opulent, or at least those in easy circumstances, amounted in 1826 only to 69,314,650 gallons; in 1828, to 136,869,438 gallons.

CONSUMPTION OF BEEF IN FRANCE.—According to M. Lullin de Chateauvieux, it appears that the consumption of *Beef* in France, in proportion to the population, is only one-sixth of what it is in England, notwithstanding that during the year 1826 no fewer than 36,518 oxen and cows were imported from foreign countries. During the same period the importation of sheep and lambs amounted to 200,000. According to M. Dupin, there is consumed in England three times as much meat, milk and cheese, as in France.

LOSS OF WEIGHT IN MEAT DURING COOKING.—Four pounds of beef lost by boiling one pound, the same quantity lost by roasting one pound five ounces; the same quantity lost in baking one pound three ounces. Four pounds of mutton lost in boiling fourteen ounces; the same quantity by roasting lost one pound six ounces; by baking, the same quantity lost one pound four ounces.

PORT WINE OF THE SHOPS.—The following is stated on unquestionable authority to be the composition, detected by analysis, of a bottle of the ordinary port wine of the shops. Spirits of wine, three ounces; cider, fourteen ounces; sugar, one and a half ounce; alum, two scruples; tartaric acid, one scruple; strong decoction of logwood, four ounces.

Stake Fence.—It is often said that the expenses attending houses and fences make slaves of many farmers. The Genesee Farmer recommends the following kind of fence as economical, and which is often seen in various parts of the country:

In making stake fence, the timber for stakes should be cut seven feet and a half long, and split to about the size of common rails; they should be set in the ground about eighteen inches, and each pair of sufficient distance the one from the other to admit a rail between them. When the stakes are thus placed, a stone of sufficient size to raise the lower rail from the ground should be placed between them, on which to place the bottom rail, and proceed to fill up by placing the ends of the two adjoining rails alternately. After the fence is about four rails high, a hole should be bored through the two stakes with an inch and a quarter augor, and a pin of good oak, or some other durable wood, drove through it, and the smaller end made fast by wedging. This pin should be placed so high, that as the stakes at the top of the ground will first fail, their length will be sufficient to allow them to be re-set; and the lower hole bored in them should be at such distance from the ground as will prevent its being brought to the surface on the second setting.

There should be two of these pins put through the stakes, the upper one only calculated to support the two ends of the upper rails, which may be raised a little above the other, and thus a fence with six rails may be made the height of seven, when allowed to rest upon each other. Such fence requires less labor for making than post and rail, by about the amount required to hole the post and sharpen the rails—is equally as durable as post and rail, and not more liable to be blown down by high winds.

Railroad Surveys.—The Board of Internal Improvements has made its report to the legislature, covering the report of Mr. Rawle, of his surveys of the Central and Yadkin railroad, which we will take an opportunity hereafter of presenting to our readers. We confess ourselves disappointed at the result which Mr. R. has come to in his estimation of the expense of constructing a railroad between this city and Beaufort. The citizens of Raleigh have just completed an Experimental Railway from the city to a Stone Quarry in the vicinity, which will not cost more than $2,500 a mile, and we had believed that the country through which the Central Road would pass is fully as favorable for such a purpose as that between this city and the Stone Quarry, yet Mr. R.'s estimate is upwards of $5,000 a mile. The expense of constructing the proposed Yadkin Railroad is estimated at between 8 and 9,000 a mile. And we presume, had Mr. R. continued his survey of the Central Road westward, the estimate would have been still higher.

We fear that if the Central Railroad cannot be accomplished at a much less sum than Mr. Rawle' sestimate, it will not, at present, be effected.

Would it not, in the mean time, be desirable, if a sufficient subscription can be obtained for the purpose, to continue our experimental Railroad to some point on Neuse River, from whence good boat navigation could be had at most seasons of the year? The Road thus made might hereafter form a part of the Central Road.—[Raleigh, N. C. Jan. 4, 1833.]

Sisal Hemp.—Under date of Nov. 13, 1832, from Port Sisal, Yucatan, Dr. Perrine says:

I am at this moment engaged in making confirmatory experiments with the Agave Sisalana. It is even much better than I stated in my paper on the Sisal hemp. There is a field of 5000 plants at only two yards apart, within three hundred yards of this table, in a very flourishing condition, although planted in the dry sand of the sea-shore, within two hundred yards of the water, which it is asserted will give at least three pounds each, annually, and need but one cutting; but as it makes very little difference *when*, a large plantation will supply work for dressing every day in the year. Heretofore it has been thought that the plant would not do well at less than 15 to 30 miles from the ocean, but this experiment shows that it will bear the sea air; and although its growth may be much slower, yet it produces sufficiently to stimulate cultivation in the worst places. Calculate for yourself 1210 plants to the acre of sandy sea shore, giving three pounds of Sisal hemp every year, after the first three or four, or we will even say five years, for ever and ever. Farewell at present, as I must see the Indian scrape six leaves of *Cheloin*, to compare their fibres with that of six leaves of the *Saoqui.*

H. Perrine.

MECHANICS' MAGAZINE,

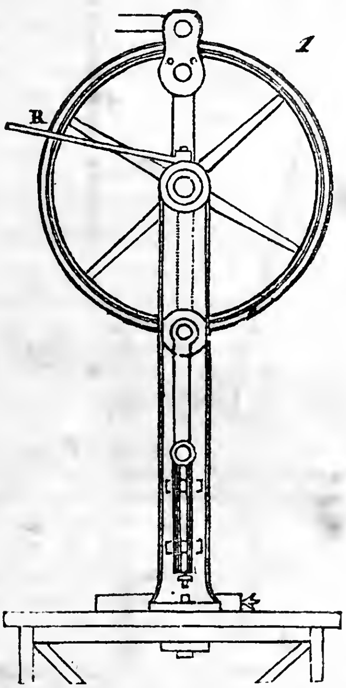
AND

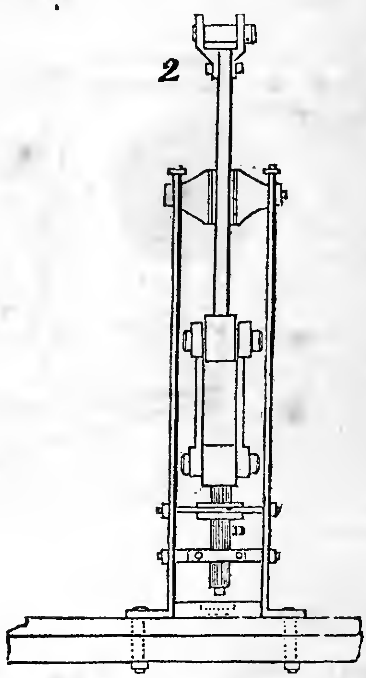
REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME I.] FEBRUARY, 1833. [NUMBER 2.

——————Art thrives most
Where Commerce has enriched the busy coast;
He catches all improvements in his flight—
Spreads foreign wonders in his country's sight—
Imports what others have invented well—
And stirs his own to match them, or excel.—COWPER.

PAPER STAMPING MACHINE.



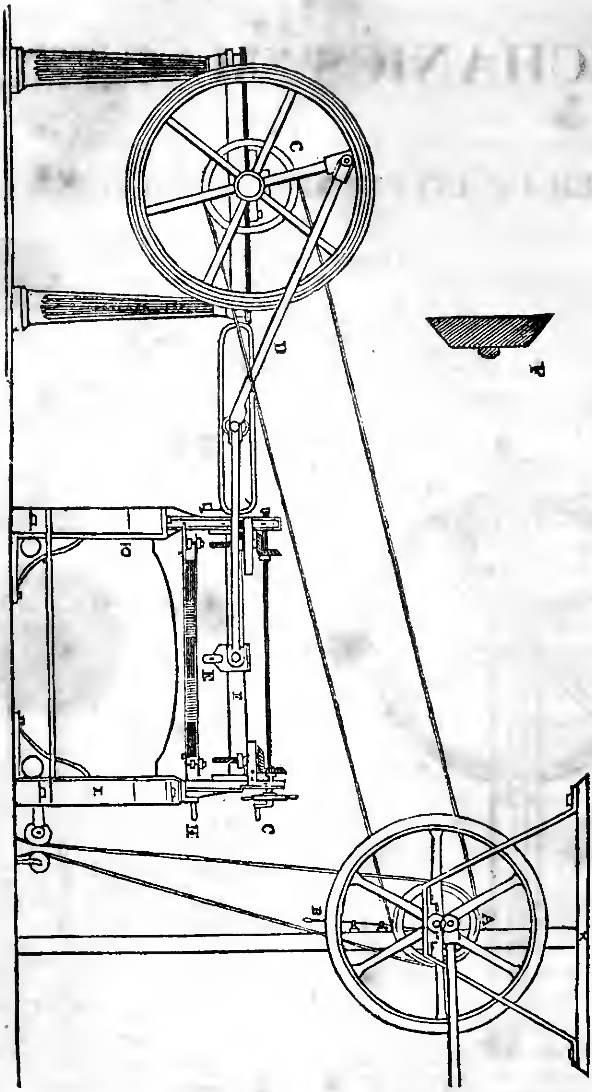


Paper Ploughing and Stamping Machines. By Mr. WM. REED. [From the London Mechanics' Magazine.]

Peterhoff Paper Mill, near St. Petersburgh, August 23, 1831.

I now propose to give a description of a machine for ploughing five reams of paper at a time, which has been at work here nearly ten years, and is an invention entirely my own. I am not aware of there being any thing of the kind in England, owing, I believe, to the excise not allowing any paper to be ploughed at the mills, so that the stationers are obliged to get it ploughed by hand. In places where there are no such vexatious regulations, this machine will be found of great use. Two boys suffice to manage the working of it; and those here have got exceedingly expert in placing in and taking out.

I shall begin with first describing the principal working parts of the machine. Two riggers, A, are driven from below off one of the engine-woolers; and on the shaft there is a sliding clutch-box with a lever, marked B, for instantly stopping or starting the machine. From one of the riggers a strap proceeds, which sets in motion the



PAPER PLOUGHING MACHINE.

rigger C, with a fly-wheel and arm D, which being connected with the head with the knife, or cutter, E, causes it to slide along the bar F, which is of a triangular form, as represented in the section F′. G is a handle, by turning which, with the help of two pair of mitre wheels, fixed on a shaft, and the vertical screws attached to the bar F, the knife, bar, &c. is made to descend. The mode of operating is as follows: On the machine table or platform, we place each ream on its beech-board, for the ploughing knife E to cut down to. We then lay on a sheet-brass gauge plate, and mark off with a pencil how much of the three external sides are to be cut away. The paper is then put on the machine, which has a sort of parallel ruler back, worked by two pinions and racks. The handle H is now turned towards the workman, and the pencil mark brought level with the front of a double iron straight-edge. The lower edge is fixed firm and level with the table; and at each end there is a $1\frac{1}{2}$ inch cylindrical pin cut, with a double screw (for dispatch) and two brass nuts, of which the lower one is round, and works slack, being intended merely to hold the upper straight edge, while the reams are put in and taken out. When the paper is in its place, the under or counter nuts are run down an inch or so; the upper nuts, which are six-sided, are screwed down tightly, by two short span-

ners, on the five reams of paper, care being taken to screw both ends of the iron straight-edge down at one time. The lads broke three cast-iron straight-edges before they got well used to the machine, by not screwing down equally. The last one I backed with two half-inch bars, clamped on edgewise, and it has lasted years. It sometimes happened that one ream of paper was rather thicker than the others; but by slackening the bar, and putting two or three sheets of paper on the thin ream, the inequality was easily remedied; now such a thing seldom occurs. After one face has been thus ploughed, the clutch is detached by the lever B, and the handle G being quickly turned the reverse way, brings up the bar with the knife or cutter E. The upper nuts are then slackened, and the parallel back, by moving the handle H as required; after which the reams are turned, and again brought up to the straight-edge.

The table and sliding-back are made of mahogany, the frame I of fir. The frame which carries the fly-wheel and rigger C, &c., is of cast iron, and square at top and bottom, with four hollow fluted columns. The guide-wheel, mitre-wheels, and the sliding parts at the end of the bar and head, are of brass kept clean. The ploughing-knives, when new, are 10 inches long, 2 inches wide, and 3-8ths thick, requiring to be very flat on the face, and stiff. I make them of English cast steel, and when worn down to about 7 inches, they are considered as having done their duty, and are then worked up into other tools. Four or five will last a year. It may be proper to add, that the post or framo marked X reaches from the floor to the ceiling, for carrying the shaft, fly, and riggers A, and that the other end is fixed on an iron cradle. The knife makes 25 double strokes per minute of 4 feet 6 inches; if the machine worked quicker, it would heat the knife.

I take the opportunity of also sending you a description of a machine for stamping the paper at the corner, in three or six inches at a time, which is worked in connection with the ploughing apparatus. It is of wrought iron, except the wheel, which is cast, and the whole is fixed firmly on a fine beech table. On the top of the frame are two stout iron rods, which help to support it from the thrusts, &c. A tapet on a short crank is put in motion from the shaft and rigger A (see ploughing apparatus,) and with the connecting rod, pushing the wheel to and fro, causes the cylinder (D, front view, fig. 2,) to rise about half an inch, which is sufficient. The peculiarity of this press is, that by one turn of the crank it makes two blows or impressions 50 times per minute. We before used a small hand press, but this is more expeditious, and saves a man, which is an object where men are scarce. In all parts of this machine, the axle and bolts are two inches thick: were they smaller, the great strain would soon make them slack in the joints. The bed-pieces are pewter or grain-tin, three inches square, and $1\frac{1}{2}$ inches thick, cast with a pin on them, thus:

to chuck them by; because when the die is forced in too deep, it is apt to cut the paper. They are then faced in the lathe, and pasteboard washer put under to raise them up to give the impression required. The tin bed-piece is let into a wooden block, that takes in two parts, with feather-nuts on the bolts, as shown in fig. 2.

BROOKLYN, Feb. 24, 1833.

To the Editor of the American Mechanics' Magazine:

SIR,—The announcement of your publication for Mechanics has excited considerable attention from the practical workmen in this neighborhood. I wish you every success. I think if you would insert in one of your early numbers a complete "GLOSSARY OF MECHANICAL TERMS," it would be highly beneficial to many of your readers and subscribers. There is one in Mr. Nicholson's "*Operative Mechanic*," a work of great merit, but of too high a price to be purchased by the mass of workmen.

I am, sir, your most obedient,

A YOUNG MECHANIC.

[We are thankful to our young friend for his suggestion, and most readily adopt it.—ED.]

A GLOSSARY OF MECHANICAL TERMS.

Æolopile—A hollow metallic ball, with a small orifice, to show the power of steam.

Anneal—To expose iron or other metals to the action of fire, in order to reduce them to a greater degree of tenacity.

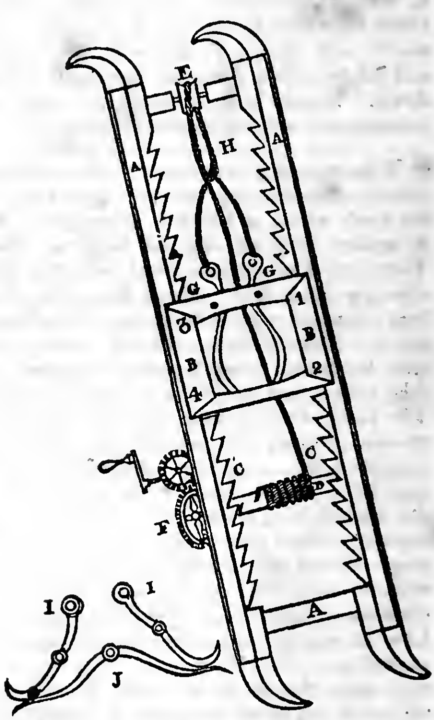
Anvil—A block or mass of iron, with a hardened steel surface, on which smiths and other artificers hammer and fashion their work.

Arbor—The principal spindle or axis which communicates motion to the other parts of a machine.

Arm—The length of the sail of a wind-mill measured from the axis.

Arms (axle)—The two ends of an axle-tree: projecting supports in machinery.
Ash-hole—A receptacle for the ashes which fall from the hearth of a furnace.
Attraction of cohesion—The attraction which holds the particles of matter to each other.
——— *of gravitation*—The force which causes all ponderous bodies to fall towards the earth's centre.
Auger—The whimble or tool used in the boring of woods.
Automaton—A machine which, by an internal arrangement, seems to move of itself.
Axis—The spindle or centre of any rotatory motion.
—— *of oscillation*—The shaft upon which any body vibrates.
—— *in peritrochio*—One of the six mechanical powers; usually called the wheel and axle.
—— *of rotation*—The shaft round which any body revolves.
Backboards—Boards attached to the rims of the water-wheel, to prevent the water running off the floats into the interior of the wheel.
Backlash—The hobbling movement of a wheel not fixed firm on its axis.
Back-water—The water which impedes the motion of a water-wheel, or from other causes.
Balance—An instrument which, by the application of the lever, exhibits the weights of bodies.
Batten—The moveable lath or bar of a loom which serves to strike in or close, more or less, the threads of a woof: a long narrow slip of wood in carpentry.
Batter—A machine used early in the process of the cotton manufacture.
Bayonet—A piece of wood or metal with two legs to disengage and re-engage machinery: *vide* Mill-Geering.
Beats—The strokes made by the pallets or fangs of a spindle in clock or watch movements.
Beetle—An implement for flattening the texture of linen or woolen cloth: a heavy mallet.
Bevel-geer—Wheels in which the teeth are set at angles of various degrees from the radius.
Bitts—Small tools used in boring.
Bloom—A bar of iron to be passed through the rollers of an iron-mill to be elongated into a bar, rod, or hoop.
Blunging—The act of mixing or kneading clay for the potter's use.
Bobbins—Little circular pieces of wood on which the thread of cotton, silk, &c. is wound.
Bolter—A machine for sifting meal.
Bolting-cloth—A cloth through which the sifted meal runs.
Brace—A curved instrument of iron or wood for moving small boring tools called bitts.
Bracket—A support fixed to a wall.
Brake—A machine for separating the cuticle or outer skin from the flax plant.
Brazing—The soldering or joining two pieces of metal by melting of brass between the pieces to be joined.
Breast—The first part of a revolver carding-engine.
Breasting—The circular sweep of masonry, &c. which surrounds the shuttle side of a breast-wheel.
Breast-plate—A small piece of steel with holes to receive the ends of a drill.
Breast-wheel—A water-wheel on which water is admitted at or nearly level with the axis.
Buff-stick—A piece of wood covered with buff leather, used for polishing.
Bullet—To alter the wards of a lock in such a manner that they may be passable by more than one key.
Bush—A hole in the nave of a wheel.
Cœteris paribus—Other things being equal.
Calibre—The diameter of a hole.
Calk—To force oakum, tow, or other material, in the joints of vessels, to make them steam, air, or water-tight.
Camb—An eccentric.
Capstan—A vertical post resting on a pivot and turned by powerful arms or levers, to raise heavy weights by crane work; a windlass.
Carbon—Charcoal.
Card—Piece of leather containing numerous iron-wire teeth, forming a species of comb: *vide* Cotton Manufacture.
Case-harden—The process of converting the surface of iron into steel.
Casting—The act of forming metal or other matter into any required shape, by pouring it into moulds while in a fluid state.
Catch—Various contrivances in mechanics, to act on the principle of a latch.
Cement—A composition for joining hard bodies.
Centre-bit—A boring tool in carpentry.
Centrifugal—Flying from the centre.
Centripetal—Flying to the centre.
Chafery—A kind of forge in the iron manufacture, where the metal is exposed to a welding heat.
Chaliometer—An instrument to measure heat.

Chamfer—A groove to receive the tenon in carpentry.
Checks—A term generally applied to those pieces of timber in machinery which are double, and correspond with each other.
Chord—Perpendicular let fall from any radius of a circle.
Chuck—That part of a lathe which revolves with the arbor: to this is affixed the article to be turned.
Circumference—The measure round any circle.
Clack—A bell so contrived that it shall ring when more corn is required to be put in the mill.
Clamp—A pile of unburnt bricks raised for burning.
Clip—An arrangement to impede velocity by friction.
Clutch—*Vide* Bayonet.
Cockling—To entangle.
Cocoon—A small ball of silk spun by a silkworm.
Cog—This word, correctly speaking, implies teeth formed of a different material to the body of the wheel; but is generally used to express all kind of toothed wheels.
Concentric—Having the same centre.
Conspiring forces—Various forces combined into one.
Constant forces—Force without interruption.
Contractile forces—Forces which decrease.
Core—The internal mould which forms a hollow in foundry: as the hollow of a tub or pipe.
Countersink—To take off the edge round a hole to let in a screw-head, that it may be even with the surface.
Couplings—To connect two shafts or spindles longitudinally.
Coupling-box—A strong piece of hollow iron to connect shafting and throw machinery in and out of geer.
Crank—A bent part of a shaft, by means of which a rectilinear motion is gained.
Crow-bar—A strong bar of iron used as a temporary lever.
Crown-wheel—A wheel which has teeth at right angles to its radii.
Cycloid—A geometric curve.
Cylinder—A long round body; a roller.
Dam—The bank or wall which pens back the water in a mill-head.
Data—Facts from which we may deduce results.
Decimeter—To measure by tenths.
Dent—The wire staple which constitutes the tooth of a card.
Diameter—The line which passes through the centre of a circle.
Devil—A machine for dividing rags or cotton in the first process of the manufacture of paper or cotton.
Die—Pieces of steel for cutting screws, having the threads countersunk on them: a stamp.
Doffer—That part of a carding machine which takes the cotton from the cylinder.
Doffing-plate—The plate which receives the cotton from the doffer.
Dog—A piece in small machinery which acts as a pall.
Draw-plate—A steel plate, having a gradation of conical holes, through which metals are drawn to be reduced and elongated.
Drench—To wet or inundate.
Drill-bow—A small bow moved by hand to impart motion to a drill.
Drum—A hollow cylinder.
Ductile—Malleable and soft.



Improved Cellar Steps. By R. Gooch. [From the London Mechanics' Magazine.]

Sir,—The prefixed is a rough sketch of a machine, which was invented by me a few years ago, for the purpose of raising casks out of cellars. A model of it was sent to the Mechanics' Institution of this city, and purchased by it—at a price, however, which

rewarded me very inadequately for the trouble the invention had cost me. The advantage of this machine over those in common use is, that provided a rope should break or slip by accident, no injury can be sustained, either to the goods or to the person employed, which now too often occurs.

AAA is a strong wooden frame, of such size and length as may suit the work or place it is intended for. The inside of the frame is rabbited, and covered with an iron plate CC, which plate is notched, and acts as ratches on each side of the machine. On these slide at liberty another wooden frame or carriage BB, and at the corners, marked 1, 2, 3, 4, there are four friction-rollers, to give freedom to its working on the plates. GG are two palls, fixed on the carriage BB, shown at II. The spring J makes the palls keep to the work and act upon the ratches CC. H is a rope, which is attached to the tails of the palls, and passes over the pulley E, and is continued to, and fastened on the roller D, which being put in motion by the winch and wheels F, will, with equal ease and safety, either raise the carriage, or let it down. Should a rope break, the palls will immediately act and stop the carriage.

Wonders of Philosophy.—The polypus, like the fabled hydra, receives new life from the knife which is lifted to destroy it. The fly-spider lays an egg as large as itself. There are four thousand and forty-one muscles in a caterpillar. Hook discovered fourteen thousand mirrors in the eyes of a drone; and to effect the respiration of a carp, thirteen thousand three hundred arteries, vessels, veins, and bones, &c., are necessary. The body of every spider contains four little masses pierced with a multitude of imperceptible holes, each hole permitting the passage of a single thread; all the threads to the amount of a thousand to each mass, join together, when they come out and make the single thread with which the spider spins its web, so that what we call a spider's thread consists of more than four thousand united. Lewenhoek, by means of microscopes, observed spiders no bigger than a grain of sand, who spun thread so fine that it took four thousand of them to equal in magnitude a single hair.—[London Courier.]

Horizontal Wind-Mill.—Mr. H. Rulon, of Mullica Hill, Gloucester county, New-Jersey, an ingenious and talented mechanic, has invented a Horizontal Wind-Mill, of an entire new plan. It has been pronounced by competent judges, as superior to all others: combining all their advantages, and retaining none of their imperfections. The difficulty and danger of managing wind-mills, in time of hard blows and blasts, has heretofore proved an almost insuperable objection to their erection. This great defect he has entirely obviated. And from the peculiar structure and formation of the wings, the power of the wind operates a third stronger, and may be managed with the same uniformity and regularity as water mills. From the simplicity of construction and formation, it may be erected at a very trifling expense.—[Camden Nat. Rep.]

[We should be much obliged if Mr. Rulon will favor us with a drawing of his invention, accompanied by a description; and we shall have great pleasure in giving them an insertion in our pages.—Ed. M. M.]

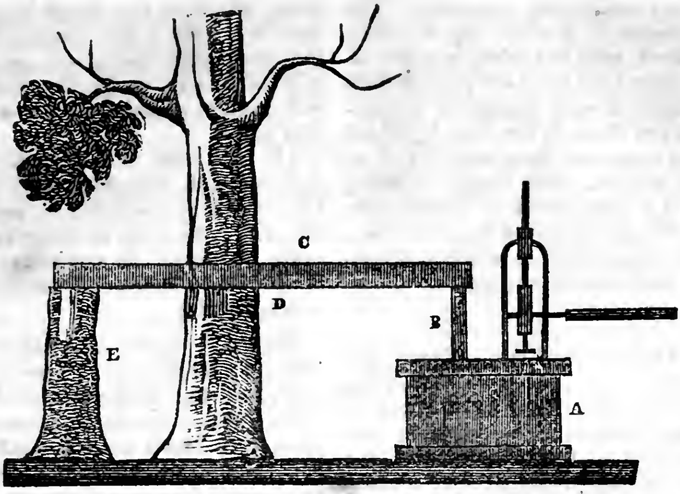
Invaluable Invention.—We on Saturday last witnessed the practical effects of a contrivance by which a pair of horses, at the option of the driver, and in an instant, are disengaged from a carriage. It is so contrived that nothing is taken from the carriage —not even the swingle trees: but the traces are separated from all these, and the horses go free, leaving the entire carriage and its fixtures, tongue and all, as if they had not been attached to it.

In all other inventions of this sort to save human life, either the fore-wheels were disengaged from the axle-trees, or the swingle-trees from the cross-bars—but in the first, the fall of the carriage would precipitate all in it out: and in the last, the horses carrying after them the swingle-trees, were not only cut, but alarmed, and for ever ruined as to all purposes of coach horses in future.

This discovery is free from all these evils, and presents to our view one of the *safest*, *simplest*, and most *admirable* plans that has ever been hit upon, and we doubt not that every owner of a carriage, whether private or public, will avail himself of the right to use this great and certain method of saving human life.

The carriage used and the harness were taken as they were found, without the entire preparation which the plan embraces. Yet it worked without a single impediment, to the surprise and admiration of hundreds. We have never seen a more useful invention.—[Poulson's Ad.]

[If the inventor will favor us with a more particular description of his plan, we shall have much pleasure in giving it publicity, and if he can accompany it with a drawing, we shall be the more obliged.—Ed. M. M.]



Application of Bramah's Pump to the Eradication of Stumps of Trees. By F. H. [From the London Mechanics' Magazine.]

SIR—Your correspondent, Mr Hounds (p. 98,) inquires for a machine to render the clearing of the woods more easy to the emigrant, and seems to think something in the shape of a circular saw most likely to supply the desideratum. Now, sir, I have always understood that the axe, in the hands of a skilful woodsman, is as efficient an instrument as need be desired for the mere clearing, but that it is the stumping, or getting up the roots, which is the most difficult part of the business, and for which some new process is the most imperiously required. The usual way, I believe, is to leave the stumps in the ground until they become rotten in the course of nature, which takes several years, during which the settler has to plough round them. Those who have capital sufficient make use of machinery, set in motion by horses or oxen, to pull out the roots at once; but this process is of course out of the reach of the poorer classes of emigrants, who have very little money to spare for implements, and none for live stock. To this class, perhaps, a machine like that represented in the prefixed figure might prove of essential service. Its cost would not be very great, and its application would be particularly easy.

A is a Bramah's pump, from its great power and simplicity the best moving force for the purpose. B, the solid piston, on which is placed one end of C, a strong beam of timber fitting in D, a notch cut in the tree to be felled. The other end rests on E, the stump of a tree, or other convenient block, near the tree operated upon. When the pump is worked, the beam C will of course be raised, and the tree must necessarily rise with it. It might perhaps be requisite to dig a little round the roots, and to cut some of the principal ones, but of course the power exerted might be increased to an immense extent, by employing a longer beam, so as to gain a very long leverage. If not used to fell, or rather to raise a growing tree by the roots, this machine might be of great service in extirpating the stumps, by means of an arrangement similar to that employed in drawing the piles of Waterloo Bridge, as described by Mr. Davy, in vol. 13, page 184, of the Mechanics' Magazine.

Another correspondent, P. M., (also on page 98,) has proposed a plan for transmitting ready-made cottages to Australia. The usefulness of this may be doubted, especially when it is recollected that a wooden house, which was sent out to New South Wales at the first establishment of the colony, to serve as a hospital, took *several months* in erecting at its place of destination, although it had been put together in London in a few hours! Besides, it will never pay to carry a ready-made house *more* than 10,000 miles.

Yours, &c., F. H.

June 8, 1832.

NEW DIVING APPARATUS.—The Board of Admiralty lately sent down to Sheerness the invention of an ingenious apparatus, to make trial of, under the inspection of Sir J. Beresford. The diver descends into the water by a ladder, where he can remain for a length of time, and can walk about the "ocean's oozy bed" with perfect safety, and even with-

out feeling any suffocating sensation. The apparatus consists of a metal cap or covering for the head, with two tubes or hoses affixed to it; these lead to an air pump, which is kept constantly at work during the descent. Two glasses are fitted in the cap, by which he is enabled to see any thing, and to pick up the smallest article. His dress, including the gloves, is a preparation of Indian rubber, so that he is not exposed to wet or cold, for upon removing the dress and cap, the diver appears perfectly dry and warm.—[Rep. Pat. Inv.]

On the Cause of Rain.—Every one must have noticed an obvious connexion between heat and the vapor in the atmosphere. Heat promotes evaporation, and contributes to retain the vapor when in the atmosphere, and cold precipitates or condenses the vapor. But these facts do not explain the phenomenon of rain, which is as frequently attended with an increase as with a diminution of the temperature of the atmosphere.

The late Dr. Hutton, of Edinburgh, is generally allowed to be the first person who published a correct notion of the cause of rain. (See Edin. Trans. vol. i. and ii. and Hutton's Dissertations, &c.) Without deciding whether vapor be simply expanded by heat and diffused through the atmosphere, or chemically combined with it, he maintained from the phenomena that the quantity of vapor capable of entering into the air increases in a greater ratio than the temperature; and hence he fairly infers, that, whenever two volumes of air of different temperature are mixed together, each being previously saturated with vapor, a precipitation of a portion of vapor must ensue, in consequence of the *mean* temperature not being able to support the *mean* quantity of vapor.

The cause of rain, therefore, is now no longer an object of doubt. If two masses of air of unequal temperatures, by the ordinary currents of the winds, are intermixed, when saturated with vapor, a precipitation ensues. If the masses are under saturation, then less precipitation takes place, or none at all, according to the degree. Also, the warmer the air, the greater is the quantity of vapor precipitated in like circumstances. Hence the reason why rains are heavier in summer than winter, and in warm countries than in cold.

Economical Stove.—Mr. Orr, of Washington, has a stove of common size in his room, which he has found by actual experiment will keep a fire burning day and night the whole year round, with one cent's worth of wood a day, at $6 the cord! The fire will require touching but twice in twenty-four hours.

[If Mr. Orr, or any of his friends, will favor us with a drawing and description of the stove above referred to, and the name of the maker, we shall be obliged; and we conceive we should be conferring a benefit on the public by inserting them in this journal. —Ed. M. M.]

To stain Glass of various Colors.—Procure a large piece of crown window glass, and place the design (which should be previously drawn on paper) beneath the plate of glass, then brush the upper side of the glass with gum-water, and when this is perfectly dry, it will form a surface proper for receiving the colors without danger of their spreading or running. The outlines of the design are then to be drawn with a fine pencil, in a black or blue color, and after they are dry they are to be laid on with larger pencils. After the colors are all laid on, they are to be again taken off those parts which are intended to be very light: this may be done by a goose-quill, cut like a pen without a slit. The glass must now be burned, in order to fix the colors, or to stain the glass with the colors which have been laid upon it. This operation is best performed in an assayer's furnace, the fire of which must be allowed to die away gradually, as soon as the colors are found to be perfectly fixed, otherwise the glass would become too brittle.

Observation.—The colors and effect of the picture are often very different, when taken out of the fire, from what they were when put into it: this however cannot be guarded against.

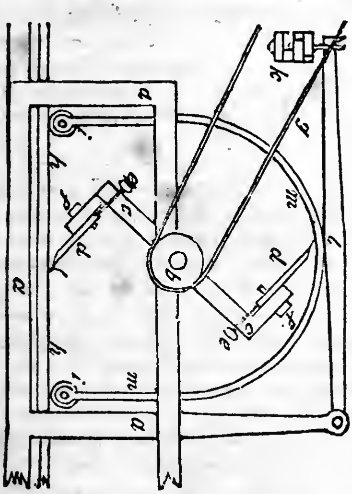
To etch Designs on Glass.—Cover the glass all over with a thin coat of bees' wax, and trace the design with an etching needle; then spread the whole over as uniformly as possible with fluor spar (Derbyshire spar) to the depth of an eighth of an inch, and when this is done, pour sulphuric acid, diluted with three times its weight of water, upon the spar. After the acid has remained upon it three or four hours it is to be poured off, and the glass washed with oil of turpentine; the etching will then appear, and the parts that were covered with the wax will have remained untouched.

Observation.—By this means glass vessels are graduated and ornamented very easily.

ENGLISH PATENT.

Patent to M. MUIR, *Engineer, for improvements in machinery for preparing Boards for Flooring, and other purposes. Granted December* 22, 1831.

In the third volume of the present series of the "Register," page 65, we have described a machine, by this patentee, for performing at once the several operations of sawing, planing, grooving, and tonguing flooring boards, and his present patent is for an addition to the same, by which the boards are reduced to a uniform thickness, and therefore completed for laying on the joists. For this purpose the boards are laid upon their faces, or planed sides, and made to pass under a set of revolving adze cutters, by which they are reduced to uniform thickness.



The annexed is a sketch of the revolving adzes, where *a a a* show a cast iron frame, with a pulley, or trigger, for giving motion to the cutters *d d*, which are connected with a horizontal axis by means of the rectangular arms *c c*; *e e* are adjusting screws, to regulate the depth of cut; and *f f* are binding screws, for securing the cutters when adjusted. *g b* show a band by which the motion of the steam-engine, or other first mover, is transmitted to the revolving cutters. *h h* show the board to be acted upon, and *i i* are two rollers resting upon the board, and by means of the weight *k*, the lever *l*, and the bent frame *m m*, prevent the board from rising while under the operation of the cutters.

The boards are brought forward to the cutters by means of a chain passing over a drum situated where the frame is shown imperfect. From different links of the chain descend hooks, which hold the end of the board and force it forward as the drum revolves, and when the last end of the board is brought under the drum it is to be pushed forwards by the introduction of another board, and a hook from the chain applied to the farther end of that, and so on in succession, during the operation of the machine.

The favorable opinion which we formerly gave of Mr. Muir's planing machine has been completely borne out by the success of the machine, and we have every reason for believing that the patent before us will prove an important addition to his former invention.—[Reg. of Arts.]

[From Babbage's Work on Economy of Machinery, &c.]

ECONOMY IN MANUFACTURING, ILLUSTRATED.—Among the causes which tend to the cheap production of any article, and which require additional capital, may be mentioned the care which is taken to allow no part of the raw material of which it is formed, to be absolutely wasted. An attention to this circumstance sometimes causes the union of two trades in one factory, which otherwise would naturally have been separated. An enumeration of the arts to which the horns of cattle are applicable, furnishes a striking instance of this kind of economy. The tanner who has purchased the hide separates the horns, and sells them to the maker of combs and lanterns. The horn consists of two parts, an outward horny case, and an inward conical shaped substance, somewhat intermediate between indurated hair and bone. The first process consists in separating these two parts, by means of a blow against a block of wood. The horny exterior is then cut into three portions by means of a frame saw.

1. The lowest of these, next to the root of the hair, after undergoing several processes, by which it is rendered flat, is made into combs.

2. The middle of the horn, after being flattened by heat, and its transparency improved by oil, is split into thin layers, and forms a substitute for glass in lanterns of the commonest kind.

3. The tip of the horn is used by the makers of knife handles, and of the tops of whips, and for other similar purposes.

4. The interior, or core of the horn, is boiled down in water. A large quantity of fat rises to the surface; this is put aside, and sold to the makers of yellow soap.

5. The liquid itself is used as a kind of glue, and is purchased by the cloth dressers for stiffening.

6. The bony substance, which remains behind, is then sent to the mill, and, being ground down, is sold to the farmers for manure.

Besides these various purposes to which the different parts of the horn are applied, the clippings which arise in comb making are sold to the farmer for manure, at about one shilling a bushel. In the first year after they are spread over the soil, they have comparatively little effect, but during the next four or five, their efficiency is considerable. The shavings which form the refuse of the lantern maker are of a much thinner texture: a few of them are cut into various figures and painted, and used as toys; for being hygrometric, they crawl up when placed in the palm of a warm hand. But the greater part of these shavings are also sold for manure, which, from their extremely thin and divided form, produce its full effect upon the first crop.

Machine for Making Pins.—Some further reflections are suggested by the preceding analysis, but it may be convenient previously to place before the reader a brief description of a machine for making pins, invented by an American. It is highly ingenious in point of contrivance, and, in respect to its economical principles, will furnish a strong and interesting contrast with the manufacture of pins by the human hand. In this machine, a coil of brass wire is placed on an axis; one end of this wire is drawn by a pair of rollers through a small hole in a plate of steel, and is held there by forceps. As soon as the machine is put in action—

1. The forceps draws the wire on to a distance equal in length to one pin: a cutting edge of steel then descends close to the hole through which the wire entered, and severs a piece equal in length to one pin.

2. The forceps holding the wire moves on until it brings the wire into the centre of the *chuck* of a small lathe, which opens to receive it. Whilst the forceps returns to fetch another piece of wire, the lathe revolves rapidly, and grinds the projecting end of the wire upon a steel mill which advances towards it.

3. After this first, or coarse pointing, the lathe stops, and another forceps takes hold of the half pointed pin, (which is instantly relieved by the opening of the *chuck*,) and conveys it to a similar *chuck* of another lathe, which receives it, and finishes the pointing on a finer steel mill.

4. This mill again stops, and another forceps removes the pointed pin into a pair of strong steel clams, having a small groove in them by which they hold the pin very firmly. A part of this groove, which terminates at that edge of the steel clams which is intended to form the head of the pin, is made conical. A small round steel punch is now driven forcibly against the end of the wire thus clamped, and the head of the pin is partially formed by pressing the wire into the conical cavity.

5. Another pair of forceps now removes the pin to another pair of clams, and the head of the pin is completed by a blow from a second punch, the end of which is slightly concave. Each pair of forceps returns as soon as it has delivered its burthen; and thus there are always five pieces of wire in different stages of advance towards a finished pin. The pins so formed are received into a tray, and whitened, and papered in the usual manner.

About sixty pins can thus be made by this machine in one minute; but each process occupies exactly the same time in performing.

The Iron of Borneo.—The iron found all along the coast of Borneo is of a very superior quality, which every person must know who has visited Pontiana or Sambas. At Bangermassing, it is, however, much superior; they have a method of working it which precludes all necessity of purchasing European steel. But the best iron of Bangermassing is not equal to that worked by the rudest Diak; all the best kris-blades of the Bugis rajahs and chiefs are manufactured by them; and it is most singular, but an undoubted fact, that the farther a person advances into the country the better will be found all instruments of iron. Seljie's country is superior in this respect to all those nearer the coast; his golloks, spears, and kris-blades are in great demand.

There are forty-nine forges at work merely in the campong of Marpow, but the mandows and spears which he uses himself, and gives to his favorite warriors, are obtained further north. Those men live in a state of nature, building no habitations of any kind, and eating nothing but fruits, snakes, and monkeys, yet procure this excellent iron, and make blades sought after by every Diak, whose hunting excursions have in view the possession of the poor creature's spear or mandow as much as his head, strange as it may sound.

Instruments made of it will cut through over-wrought and common steel with ease. We have seen penknives shaved to pieces

with them by way of experiment; and one day a wager of a few rupees having been made with Seljie, that he would not cut through an old musket barrel, he without hesitation put the end of it upon a block of wood and chopped it to pieces without in the least turning the edge of the mandow.

In the sultan of Cotti's house there are three muskets, formerly belonging to Major Mullen's detachment, which are each cut more than half through by the mandows of the party which destroyed them. This circumstance being mentioned to Seljie, he laughed, and said that the mandows used on that occasion were not made of his iron, otherwise the barrels would have been cut through at every stroke.—[Abridged from an article in the Singapore Chronicle.]

Remarks on Mr. White's experiments on the cohesion of cements, with a tabular view of their results, reduced to a common scale. By B. Bevan, Esq. [From the Philosophical Magazine and Journal.]

Gentlemen,—The papers on cements, communicated by Mr. White, and published in the Philosophical Magazine and Annals, N. S. vol. xi. pp. 264 and 333, are of considerable importance on account of the numerous facts they contain. They enable the architect and builder to know where, and in what manner, to apply the different kinds of cement, and the degree of stress which may safely be laid upon them.

A careful perusal of the numeral results will point out several common errors, in respect to the cohesive properties of the Roman cement and pozzolano, under different modifications, and under various degrees of exposure to moisture.

And as you probably may be of opinion that an abstract of the results given in those papers, reduced to one common scale in a tabular form, may be acceptable to some of your readers, and save much time to individuals I take the liberty of sending one.

		Cohesive strength per inch. lbs.	Mean.
Cement in bars,			
Age 6 days,	1 dry - -	474	
	2 variable -	360	356
	3 wet - -	234	
Age 47 days,	1 dry - -	516	
	2 variable -	564	450
	3 wet - -	270	
Age 94 days,	1 dry - -	210	
	2 variable -	618	380
	3 wet - -	312	
Age 187 days,	1 dry - -	534	
	2 variable -	708	519
	3 wet - -	336	
Mean of the dry - - - - -			433
variable - -			562
wet - - - - - -			288
With salt water, - - - - - -			924
With 51 per cent. of water, - -			330
With 64 do. do. - -			215
3 parts cement, 2 parts sand, -			456
1 part cement, 1 part brickdust,			312
Bricks,			
3 pts. cement, 2 sand, 6 months,			375
3 do. 2 ? - -			362
All cement, - - - 9 months,			360
Paving bricks, best sort, - - -			253
Do. seconds, - - -			194
Common building brick, London,*			43
Common bricks, Soho, - - -			412
Brick cylinders,			
Laid in cement, - - - - - -			27
Laid in cement and sand, - -			58
———————————, - -			48
———————————, - -			53
Brick piers,			
Laid in cement, 2 parts, rough lime, 1 pt. sand, $1\frac{1}{2}$ parts,	1 month		$4\frac{1}{3}$
pozzolano, 3 pts. docking lime, 1 p	6 weeks		7
pure cement, - - -			21
pozzolano, 1; stone lime, 1, - - - - -			$8\frac{1}{4}$
Atkinson's cement, 1; sand, 1, - - - -			$25\frac{1}{4}$
ditto, - - - - - -			$49\frac{1}{4}$
cement, 4; lime, 1, - -			17

The apparent deficiency of strength in these experiments probably arose from the position of the resultant and strain in being on one side instead of in the middle of the piers.

Force required to crush, per square inch.

P. 337.	lbs.
A 14 inch brick pier, laid in cement,	470
Pozzolano, 3 pts; ground lime, 1,	296
Atkinson's cement, 1; sand, 1,	410
Pozzolano, 4; lime, 1, - -	638
Ditto, 3; Dorking lime, 1, -	600
Stone-lime, 1; sand, 3, - -	500
Portland stone pier, - -	2300

Yours, truly, B. Bevan.

P. S.—From the disproportions between the cohesive strength of pure cement and cement used in brick work, it is desirable

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* Stowbridge fire bricks have a strength of 790 lbs. per square inch. The bricks I used at Greenwich Well were made at Fenny Stafford, and would support 715 lbs. per square inch; equal to the strength of Yorkshire stone.

that further experiments should be made on this subject.

A NEW MATERIAL OF BUILDING has been employed in a wall which Mr. W. Ranger is now erecting for Mr. Lawrence Peel, behind that gentleman's mansion in Kemp Town, that will, without doubt, come into general use, and probably in the end supersede brick throughout the country. In appearance it has all the nobleness of stone, and its durability is equal, while its cost is in the proportion of only one to three. The principal ingredient is the grey lime of our own Downs, which is manufactured into a concrete mass. It is impervious to wet, so that houses built of this material must, of course, be warmer than at present; and it has this further advantage, that it can not only be moulded into stones of any shape or size, but may even be worked up on the spot so as to form one solid unbroken mass.—[Brighton Gazette.]

[From the London Mechanics' Magazine.]

PROOF OF THE ADVANTAGES OF LONG LEVERS IN LOCOMOTIVE MACHINES.—Sir: I had written separate replies to most of the opponents of my theory of locomotion; but, finding in their papers so much truth intimately mingled with so much error, I perceived my remarks were, and must be, far more extended than I wished them to be, or than your pages would reasonably permit. I therefore thought all useful purposes would be answered by sending the following conclusions, arrived at by the various reasonings of your correspondents, and by multiplied experiments of my own, by which they will see how far I am convinced of the truth of what they have advanced, and how far I retain my original opinions: such are the beneficial uses of discussion.

Conclusions.—1. That my 8th proposition, vol. 15, page 44, is virtually admitted, and that the fulcrum of locomotion is the ground. This renders it unnecessary to send the promised drawing of a carriage, without spoke or axle, and here I particularly wish to give part of my intended answer to S. Y., page 94. He says, "the difficulty of obtaining those outward abutments" is the great obstacle. I agree with him, that it is one great difficulty, that is to obtain abutments of sufficient hold or strength; he wants an iron cog rail, to use a great force at, with a short lever; but that a common road will never furnish; the abutments must be taken as they are; and by using a long lever and light power in emergencies, those abutments may be made, in all useful cases, sufficient; instance, a ton-weight, balanced on an equal armed lever, will require another ton, therefore the fulcrum or abutment will carry and be forced by 40 cwt.; but if you balance the ton on a 20 to 1 armed lever, the fulcrum will only be forced by 21 cwt. and may hold when it would not with 40 cwt. This I consider a good and true illustration, in some cases, of the force of long levers on my locomotive fulcrums, and of the advantage of such levers.

2. That my 9th proposition is not to be considered as an universal one, because a locomotive machine may be worked by levers of the second order, as well as by those of the first order, as is exemplified below.

3. That an open-topped steam cylinder has a different effect on a locomotive machine to a close-topped cylinder, is again different in its power of locomotive action to a horizontal one, and that the action of spur or bevil gearing is different in effect to the action of cranks of the same radius.

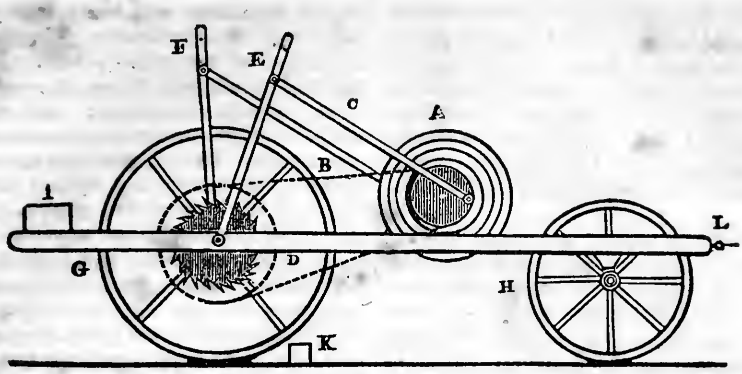
4. That my 5th proposition is only partially correct, being right in some cases, and wrong in others; consequently, that the theory of the application of power in various ways to a locomotive machine must be divided into two or more classes, each class embracing two or more orders, which classification I shall hereafter describe. The following leading principle, mentioned vol. 15, page 150, I think includes all classes: "There cannot be advancing motion produced by any machine, animate or inanimate, unless the power attempting to produce such motion can ply against an abutment or fulcrum that is either immoveable or much more slowly moving than such power of advancing motion."

5. That a short lever can effect on cog-rails, that which it is impossible for it to effect on a plain road with plain wheels.

6. (And which is the burden of all from the beginning.) That gearing of long radius will practically pass a locomotive machine with plain wheels through difficulties which gearing of short radius cannot do.

Any remarks upon these conclusions I shall be happy to peruse, and to reply to: and if I have not heretofore written under such equanimity of temper as some of your correspondents, it has arisen more from playfulness of spirit than from any unbecoming feeling, but I will restrain it in future.

I have long been trying to work a locomotive machine by a lever longer in its power-



arm than the radius of the wheel, and am happy to send you particulars of a successful experiment to that effect. The singular motion of a pin on the rim of a coach wheel has often been remarked, and the nature of the cycloidal curve explained, but until the promulgation of the wheelbarrow problem, vol. 14, page 191, I do not know that the locomotive advantages of this curve have ever been known or applied. In making a complete revolution of a locomotive wheel, the point that first touched the ground moves forward the same distance that the axle does (see page 8); but in moving this distance, it first proceeds very slowly, then very rapidly, then slowly again, so that the top of a wheel is always advancing very much faster than the bottom. In making only one-eighth of a revolution, the top starting point of the wheel will have advanced more than 12 times as far as the bottom starting point—consequently, by constantly making the top of the wheel the place of the power, and constantly making the bottom of the wheel (as it is) the place of the fulcrum, and the axle the place of the locomotive resistance (as in a second class lever), a small power may be made to have a great effect, as in the wheelbarrow problem, *especially if the top radius of the wheel can be lengthened without lengthening the bottom.* This, as the following experiment shows, may be done, and in theory may be done without limit, so that a power (abating friction), however small, may be made to locomote a weight, however large, over an obstacle of any definite height. Can Science do more for locomotion than this?

[*See engraving at the head of the page.*]

Let A be a locomotive power (I used a strong spiral spring) turning a wheel carrying two or more, if needful, pins; B C, two or more connecting rods working on these pins.

D, two or more ratchet wheels fastened to the axle of the carriage wheels; E F, two or more main levers pulling round the ratchet wheels one way only, and slipping the other way.

G H, wheels of the locomotive carriage.

I, a balance weight to keep plenty of pressure on the ground and obstacle K.

N. B.—This weight must be particularly attended to, if any one repeats the experiment.

Now, the motion of the spring wheel, A, alternates the main levers, and propels the carriage, something like the little predomotive vehicles described in Treatises on Mechanics, but on quite a different principle as regards situation and leverage. The longer these main levers are the less power will be requisite to effect the motion, and any obstacle can be locomoted over with plain wheels that the wheels will hold on without slipping. A carriage might be worked on good ground, with only the common power requisite for a level road, by any ordinary gearing (represented by the dotted lines,) and a pair or more of these levers, occasionally used, would take the carriage through any difficulty.

I placed the machine on a level plane, with an obstacle K under the power wheel equal to one-tenth the distance of the wheel. I then tried how much statumotive, or horse power, at L, must be exerted horizontally to draw the machine over the obstacle, and found it, say, 56; I next wound up the spring until it indicated a power equal to 56, and when the connecting rods, B C, were fastened to the levers, E F, near to the full radius of the wheel, this power of 56 also locomoted the machine over the obstacle. Again I shifted the rods until they were attached to the levers, E F, considerably beyond the rim of the wheel, when a power on the spring,

equal to 25, effected the locomotion over the obstacle, and I believe I could have lengthened the levers until a power of 5 or less, or even a fraction, would have effected the same locomotion (slower, of course.) Next I attached the rods to a short radius on the levers, when it required a power on the spring equal to 200 to effect the locomotion over the obstacle.

This I consider a very successful experiment; forcibly showing the power and practical advantages of long levers in surmounting locomotive difficulties—as in extreme cases, we can have the leverage of large wheels without the incumbrance of their weight.

A permanent power of 25 might be amply sufficient for such a machine as this to carry; whereas, without a shifting leverage, it must carry a power of 200 or more to meet extreme cases. This little machine, with plain soled wheels, mounted an inclined plane, rising 9½ in 20, and with cogged wheels, 12¼ in 20, thus out-triumphing the "Triumph," whose model's best performances, with plain wheels, only ascended a rise of about 7 in 20! the abutment being more forced at than in this machine.

I cannot become coach proprietor or common carrier; but I hope Mr. Gurney will be induced to try the effect of occasional long levers—he need not then fear any hill or newly made road that horses can travel upon. As I before stated, I see no obstacle to the success of steam carriages on common roads but their vast weight in proportion to their power; and this obstacle I know not how to overcome without abatement of speed.

Yours, &c. SAXULA.

December 12, 1831.

[*For the American Mechanics' Magazine.*]

NASHVILLE, Tenn. January 28, 1833.

NAVIGATION OF THE OCEAN BY STEAM.—I am confident that in a short time the Atlantic will be subjected to safe, cheap, and regular steam navigation. The principal objections are, want of fuel for a long voyage, roughness of the waves, and obstruction of the boilers by salt water. These difficulties will be obviated by the plan I propose.

It has been ascertained from scientific measurement that the waves of the Atlantic never rise in time of storms more than twenty-four feet high; and the breadth nearly double the elevation. To overcome waves 24 feet high by 48 wide, it is necessary to build a large vessel, near the size of our 74 gun ships, 300 feet long and 70 wide. The largest steamboat was lately built at Pittsburg, the Mediterranean, 196 feet long, and boiler of 400 horse power. A boat of 300 feet would ride across six waves, as on joists, equally sustained; and the width would fill the space between waves, and prevent rolling. The engines, one on each side, of 500 horse power, and 48 feet diameter of wheel, would have a slow stroke, suitable to take hold passing from wave to wave at twelve miles per hour; and cross the Atlantic, 3000 miles, in ten or eleven days. Built for passengers and not for freight, it would carry 1500 tons of coal; and consuming 100 tons a day, an ample supply for ten or fifteen days. It should also be provided with masts and sails, to run with fair winds, and prevent accidents; and to obviate obstructions of the boilers by salt, might be provided with two engines on a side, to run alternately, while the salt was being removed.

This large vessel, suitably constructed, would run proportionably faster, from the increased elasticity in a greater extent of moving medium, as a large fish will outrun a small one; and the rule will hold from the smallest to the largest moving body. This size would conveniently carry one thousand cabin passengers, and reduce the price (in the present ship packets, $135,) to $100 a passenger, would be $100,000 a trip; and crossing and recrossing in a month, would be $200,000; and in a year $2,400,000. A seventy-four, manned with 1,000 men and ready for a cruise, costs 1,000,000. This steamboat would not cost more than half as much; perhaps the cost and expense for a year's running would not exceed that sum—if so, the profit would be $1,400,000. But in these details I have by no means correct data, and only give a conjecture for the investigation of experimental men.

To test the plan, a voyage could be first made from New-York or some eastern city, touching at the Chesapeake, Charleston, Havana, and New-Orleans. If it succeeded, then Europe would be brought relatively three or four times nearer to us; and there would be no lack of passengers and competition. For who would not at such a cheap cost visit England, France and Germany; or even make a fashionable trip of a few days up the classic Mediterranean, to Italy, Greece, Egypt, and Palestine, where civilization, language, laws, and religion, had their origin.

The Pacific Ocean would be the most easy to navigate, even with our common steamboats, if they were large enough to carry fuel. From the mouth of Columbia river, by

the Sandwich Islands, (a coal deposit,) to China, the voyage might be made over the calm unruffled Pacific in twenty days or less. A steamboat ascended the Missouri last season 2000 miles; and they can go within less than 200 miles of the navigation of the Columbia river. A railroad across, by this route, and Asia would be relatively nearer to us than Europe is at present. What a theatre this for the enterprize of our countrymen! The steam engine is the most important modern invention. As a stationary power it forms a new era in the arts. Its application to navigation and locomotion is making great progress in facilitating intercourse. The success of locomotive engines on common and M'Adam roads is now certain, and their rapid motion on railroads is wonderful. In navigation, in stemming the torrents of rivers, the steamboats, those immense moving hotels, excite our admiration.

This portable elastic power is now felt, or soon will be, throughout the land, on all the rivers, and lakes, and borders of the ocean, from the Atlantic to the Rocky Mountains and the Pacific, carrying in its train the blessings of civilization, intelligence, and science, till the lonely and remote savage wilderness will resound with the hum of population.

The ocean, which covers three-fourths of the earth, and separates nations and continents by boisterous and dangerous waves, the sport of the capricious winds, will soon yield its listless force to the all-subduing power of steam, guided by science.

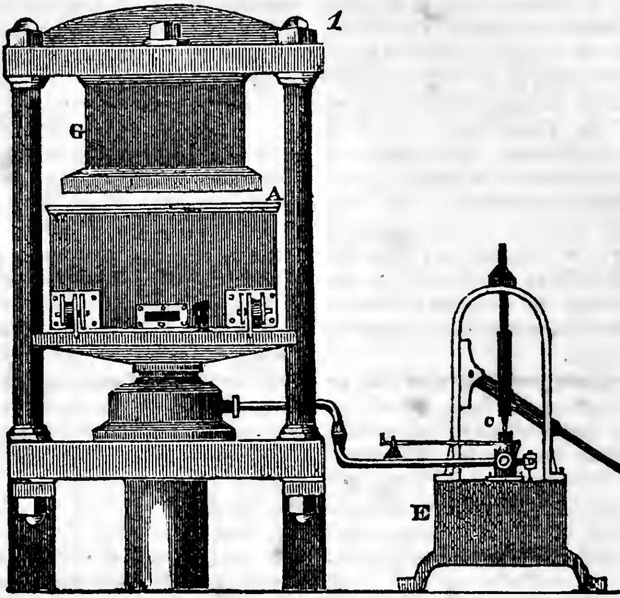
Intending, when I had more accurate information and leisure, to make a communication, my attention was called to the subject by the British journals. In the London Quarterly for March last, page 42, it is claimed as a most important point of national superiority of Britain over our country, that they navigate the ocean by steam; while our steam navigation, confined to the rivers, will not fit our *Steamermen*, as the reviewer says, to navigate the ocean. I am not sure that our tide-water steam navigation, in Long Island Sound, the Chesapeake, and the Lakes, and along the Atlantic from Maine to Florida, and in the Gulf of Mexico, is not at least three times the extent of their *Channels* of the same kind. I read a statement with much pleasure in a late eastern paper, that, on the first instant, the steamboat David Brown made the passage from New-York to Charleston, each way, in four days running. An extract from the United Service Journal in your journal of the 5th inst. on "Steam Vessels of War," shows what high importance is attached to that subject in England.

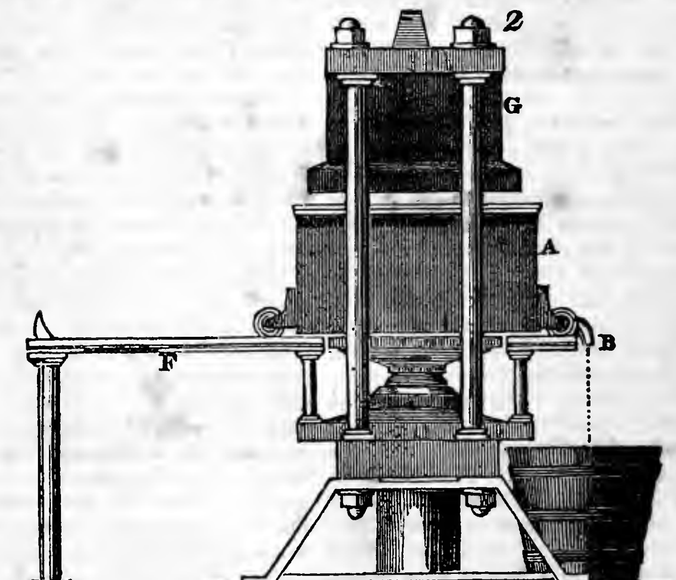
It should never be laid as a reproach to our country that any foreign nation outstrips us in a species of navigation which our country justly claims the honor of having originated; and which at no distant day is destined to change the mode of warfare on the ocean. J. McC.

[*From the American Railroad Journal.*]

Foot Railroads, No. III.—There is enormous expense attending the repairs of our common roads. From some inquiries I have made I calculate that the cost of keeping roads in repair is about one dollar and a half to every inhabitant, or 3000 dollars to a town of 2000 inhabitants. In towns near to great markets the cost is still more; and after all the labor bestowed upon them, they are and must be in a bad state in the spring and fall. In most directions there is not business enough to sustain railroads for steam-carriages, or even for horse labor; but light and narrow railroads might be made, on which men might work, and do all the transportation that is needed. They could transport 600 tons a day, or 180 millions of feet of boards, or other lumber, a year. A railroad, then, for human power would answer all the purposes of such an establishment from most parts of the country to a market town. A few such routes into the country would collect all the travelling upon them, and would save the common roads; and the expense of erecting these railroads would be trifling compared with the cost of the heavy railroads formed for horses or steam engines. It would not be hazardous for some enterprising men of business to make an experiment on a limited scale. The experiment, however, should be scientifically made, for nice precision is here required. It belongs to those who have access to scientific and practical men—and who have some business to transact—and who have a favorable location near them, to make an experiment. And an experiment for a mile, or even a shorter distance, may determine the question for the whole country. It may show that a new mode of communication may be opened between cities and towns. And it may be that, instead of men being moved by cattle, cattle could be transported by men on railroads even easier than they can be driven along a high-way. But experiment must decide this question. And yet it would seem that it is decided already. We know that a horse wil

move ten tons on a level railroad; and we know that a man has about the seventh part the strength of a horse—and we know that he can easily move at the rate of two miles an hour; and we might set it down as a decided point, that a man can move on a level railroad so great a load that it would be a public convenience to have railroads for the application of human strength for purposes of trade. PUBLICOLA.





[From the London Mechanics' Magazine.]

RUSSEL'S HYDRAULIC PRESS.—We see no reason to doubt that this press of Mr. Russell's is as applicable to the expression of the juice of apples and pears, as to any of the other purposes to which it has been so successfully applied. Neither can we refuse to acknowledge that it is, in point of simplicity

and probable efficiency, superior to any thing of the kind which has yet appeared in our pages. Our Devonshire and Hertfordshire friends must feel obliged to Mr. Russell for making this description of it public. We have seen a sugar apparatus fixed on this plan, in which there are two boxes running alternately on the railway, so that the sugar in one box is submitted to the action of the press, while the contents of the other are removed, and a fresh charge put in, ready to wheel into the press as soon as it is at liberty; by this means, nearly double the usual quantity of work is done in the same time.—[Editor Mechanics' Magazine.]

Sir,—Seeing in No. 438 of the Mechanics' Magazine, an engraving and description of an Hydraulic Cider Press, with what appears to me a complex apparatus to work it; and having had longer practical experience in the manufacture of hydraulic presses than I believe any individual in existence, I am induced to send you a drawing of an apparatus of this sort, which I have lately fixed at the Refuge for the Destitute, for the purpose of pressing the rinse water from the linen, woollen, and other articles, washed at that establishment, instead of wringing; and which is, of course, equally applicable in all cases where similar pressure is required.

Fig. 1 is a front elevation of the press, without its railways.

Fig. 2 is a side elevation, with the addition of the railway.

The squeezing box, A, has a perforated lining and bottom, through which the water passes, and runs off at a spout, B, at the back of the box. The diameter of the working piston of this press is four inches; that of the injecting pump, C, is one inch diameter; and the power of this press on the article submitted is upwards of 30 tons. If the piston of the injecting pump were one half an inch in diameter instead of one inch, the power would be increased fourfold, that is, 120 tons pressure on the articles submitted, with the same labor at the pump. When the linen, &c. is sufficiently pressed, that is, almost dry, the pressing box is lowered down, by opening the discharging valve, D, on which the water returns back to the cistern, E, on which the pump is fixed. The squeezing box is then drawn out on the railways, F, emptied, re-filled, and wheeled back for a second charge, and so on. I should have observed, that the mallet, G, which is fixed at the head of the press, enters the box, and is made to fit nearly.

Having made and erected many presses of this description, for expressing the oil from various seeds, the molasses from sugar, &c. their power varying from 500 to 1000 tons pressure, I take leave to ask your opinion, whether a press so constructed and shown in the drawing accompanying this communication, is or is not as applicable to pressing apples for cider, pears for perry, or any other fruit, in a superior manner to the methods which have already appeared in the Mechanics' Magazine?

Should you be of opinion that it is superior, you will probably be inclined to give it a place in your truly useful work.

Yours, &c. W. Russell.

Improved Method of using Wheel-Drags. By W. Baddeley. [From the London Mechanics' Magazine.]

Passing down Ludgate hill the other evening, I noticed a very heavily laden west-country waggon going down the hill, with one of the wheels locked; the consequence of which was, that the friction of the wheel upon the stones caused the evolution of considerable heat which dried up the road in the track of the wheel, and at length produced a charring of the fellies, as was shown by the escaping of small quantities of smoke, accompanied with a strong smell of burning wood. On reaching the bottom of the hill I went up to the waggon and found that it was furnished with a proper shoe, or drag, but that the driver chose to *lock* the wheel in preference to using the drag. The reason appeared to be, that the former was the *easier* method; for if the shoe had been used, it would have been necessary to *back* the waggon out of it, whereas the locking chain was disengaged in an instant, by simply striking off a ring.

Few persons are perhaps aware of the extent to which wheels are continually injured by this practice; first, by the actual wear of the iron tire; and, secondly, by the mischievous effects of the heat upon the wooden fellies. I have repeatedly observed on Ludgate and Holborn hills, and other places, both in town and country, that unfortunately this is a regular practice, partly arising from laziness, and in part from the real difficulty of backing a loaded vehicle out of the drag.

It has therefore occurred to me, that a very simple remedy may be provided for this evil by rendering the use of the shoe *as convenient* as the lock chain. And this may be done in several ways: thus, for instance,

by using a drag chain of such a length as to permit the wheel to roll off, and to take it up short enough to carry the wheel, when it is to be dragged by the same simple fastening at present used for the locking chain; viz. a ring sliding on a bent pin. In this way the drag may be used, and when the vehicle reaches the bottom of the hill, it may be instantly and easily disengaged, and when the wheel has rolled off may be hooked up out of the way. Or the shoe may be permanently fixed by a chain behind the wheel, and connected with the chain drag, when required, in the way before mentioned; when done with, it may be disengaged from the drag-chain and replaced behind the wheel.

[From the London Mechanics' Magazine.]

Domestic Self-Acting Pump.—Sir: I am desirous of knowing whether any method has been used to apply the force of a small stream of water, having a fall of about 60 or 70 feet, by hydraulic pressure, to raise a large portion a less distance. I want such a force to produce power by raising a portion of water about six or eight feet in height, into a water-wheel, by a stream about 300 yards distance, having a fall as above. It will be seen from the subjoined, from the Imperial Magazine, that such a method has been tried on a small scale with success.

I remain, Sir, yours, respectfully,

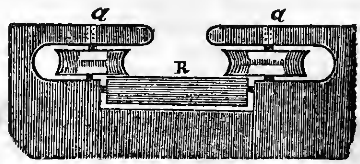
A. B. C.

"That such a pump is perfectly applicable to all domestic purposes is proved by the fact of a very small one having continued working for three months without being touched, raising about two tons of water in 24 hours; it acts entirely without friction, and by its means the rain water collected at the top of the house will pump up a corresponding quantity of water from a well as deep as the house is high. Its principle depends upon the alternate filling and emptying of four reservoirs with air and water, by means of pipes and valves: invented by Jas. Hunter, Esq. of Thurston, in Scotland —the principle of which is to raise water above the original reservoir by the descent of a certain portion of it."

[From the London Mechanics' Magazine.]

Improved Leading Blocks.—On examining some "leading blocks," as they are technically called, a short time since, I was struck with the appearances which many of them presented. In some, the pulley had set fast, and one side had been cut into by the rope, while in all, the way between the pulley was cut into deep grooves, evidently showing the existence of great mechanical disadvantage, where the reverse would have been highly desirable.

It occurred to me at the time, that a little addition would make a great improvement in this useful machine; and I send a sketch of a method of construction that would be found very much superior to those at present employed.



The prefixed sketch represents the side of a ship, or dock, &c. &c.; *a a* are two gun-metal sheaves, turning on iron axles, and having more end play than is usual. The sheaves rest upon a metal roller, R, which runs freely upon an iron axis.

The roller should be closed in, about half way up, both on the outside and within—[omitted in the sketch for the sake of distinctness, nor is it absolutely necessary.] The framing of the block should be lined with iron, and the whole should be kept well greased, to reduce the friction and prevent corrosion. With this form of block, the friction, and consequently the labor, as well as the wear and tear of ropes, would be greatly reduced. For, if the rope happened not to run against either of the sheaves, it would still work upon the roller, where motion would be almost as free.. If the rope took into a sheave, that and the roller would turn together; the other sheave would be at liberty to turn with the roller, the friction between them most likely being sufficient to communicate motion.

The increased efficiency and durability o these blocks would amply repay the additional expenses of construction.

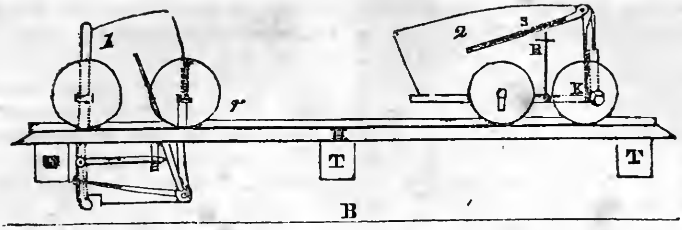
Yours, respectfully,

W. Baddeley.

London, Sept. 27, 1832.

[From the London Mechanics' Magazine.]

Improved Excavator's Waggon.—Sir: The accompanying sketches represent an improved sort of waggon, which was used for removing the earth at the excavation of the new entrance to the London Docks. It is a well known fact, that if clay is mixed with water and a little sand, it forms so compact and cohesive a mass, that, when carted



to a distance of two or three hundred yards, it is next to impossible to uncart it without the help of pickaxe and shovel. The soil to be excavated in the present instance being very much of this description, it was the general opinion that the ordinary kind of excavator's waggon would be of little use; and being in the employment of the contractor for the work, I therefore set about contriving such an alteration in the construction as might meet the difficulty of the case. After several trials, with different models, the one of which I now send you a description was found the most suitable. We had a good many waggons constructed on this plan, and I was very happy to find, that when the mode of using them came to be understood by the workmen, they answered our purpose admirably.

Description.—Fig. 1 is a side view of the waggon when emptying. B shows the line of the barge at high water. T T T are whole timbers. H are half timbers on each side of the waggon to secure the iron rail, *r*. The distance from T T, and also between the rails, are left open to allow the tail of the waggon to drop through, as in fig. 1.

Fig. 2 shows the method of securing the tail-board at top and bottom. At J is a joint to allow the wheels to run out, and at K a catch to secure the axle; *s* is a strap, bolted to the side, to secure the tail-board at the top.

The course followed on emptying the waggons was to push them forward to one of the timbers, as at T, and then to allow the bottom to slide down the timber gently. A man on each side then pulled up the rods, as at R, which lowered the catch, K, when immediately the wheels went out, down went the waggon, and the earth dropped out. Nine times out of ten the clayey mass went down into the barge as solid as if it had never been dug. I had almost forgotten to add, that the waggons were about 4 inches wider at the tail than at the head. The drawings show the axles bent, but they were not all so; the more bent, however, the axles are, the more easily the waggons are managed.

Yours, &c. J. Walker.

Great Canal of Goetha.—This magnificent water-line, which passes through the heart of Sweden, and unites the North Sea and the Baltic, was opened with great solemnities on the 26th of September last. It will admit vessels drawing nine feet and a half of water, and two and twenty feet in width; and they make the passage into the Baltic in eight days, with the aid of steamboats across the lakes with occur on its line. It has been two and twenty years in constructing, and cost rather more than 10,430,000 dollars (£1,285,000) of which 6,378,334 dollars were contributed by the state.—[Athenæum.]

Application of Projectiles to Rescuing from Fire. [From the London Mechanics' Magazine.]

We extract from the "Supplement" alluded to in the article on "Mr. Murray's Plan of Instantaneous Communication with Stranded Vessels," (see page 39,) the following proposition for the application of Mr. Murray's pistol and arrow to the purposes of a fire-escape:

"I have already particularly referred to the application of the arrow and line to the instantaneous formation of fire, and it has been mentioned that the cord projected over a building was found quite sufficient to draw a rope over the roof. The suggestion was to make it thus effective for an extended rope ladder, which might be instantaneously formed on both sides of the building. The parallel ropes employed in the formation of the rope ladder must needs be kept separate by bars of wood alternating with rope, in order to prevent approach; and a single rope would suffice, there being steps attached to the side like the stirrup, the footstep having its base formed of wood, which would thus preserve an open space; the rope might be either projected at once over the roof, and fastened on the opposite side, or the arrow be fired into one of the highest windows, or wherever required; to the top of the rope attached to the line might be fastened a lantern, to direct proceedings; a hammer and staple with a tally, instructing the inmates to drive the staple firmly into the

floor, for fastening the rope of escape to it. For the purpose of facilitating the descent of the timid or helpless, the rope referred to might be supplied with two or more blocks, with pullies on each side, through which a patent sash cord might pass for the purpose of raising or lowering a square basket, for the reception of invalids, or females and children; and by the steps provided, some intrepid and enterprising individual might ascend for facilitating the rescue of the infirm and timid.

"There are cases wherein no fire-escape hitherto proposed would have proved effective in saving the helpless inmates. I may mention, as an instance of this description, the conflagration of Mr. Haigh's cotton-mills, at Colne-Bridge, near Huddersfield, some years ago, and in which seventeen individuals perished, as recorded in the pyramidal tomb reared over their ashes in the neighboring church-yard."

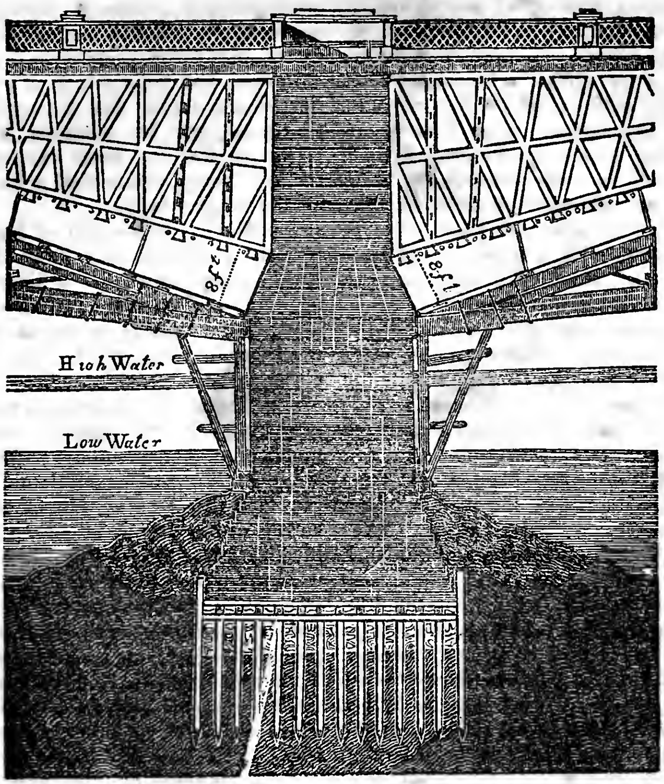
A mode of rescue similar to this of Mr. Murray's—only that a cross-bow is used instead of a pistol and arrow—has been already successfully reduced to practice by the admirable fire-establishment of Edinburgh. As the Edinburgh arrangements for the purpose are more complete than those of Mr. M., and are most of them equally adapted to the present invention, we shall here add the account given of them by Mr. Braidwood, in his excellent work on fire-engines, (Edinburgh, 1830.)

"The apparatus necessary for this fire-escape is a chain ladder, 80 feet long, a single chain or rope of the same length as the ladder, a canvass bag, a strong cross steel bow, and a fine cord of the very best workmanship and materials 130 feet long, with a lead-bullet of 3 ounce weight attached to one end, and carefully wound upon a wooden cone, 7 inches high, and 7 inches broad at the base, turned with a spiral groove, to prevent the cord slipping when wound upon it; also, a small pulley with a claw attached to it, and a cord reeved through it of sufficient strength to bear the weight of the ladder. In order to prevent the sides of the ladder from collapsing, the steps are made of copper or iron tube, fastened by a piece of cord passed through the iron tube and into the links of the chain until the tube is filled. The steps thus fastened are tied to the chain with No. 14 copper wire, so that in the event of the cord being destroyed, the steps will be retained in their places by the wire. The ladder is provided with two large hooks at one end, for the purpose of fixing it to a roof, window, sole, &c. The bag is of No. 3 canvass, 3 feet wide and 4 feet deep, with cords sewed round the bottom, and meeting at the top, where they are turned over an iron thimble at each side of the mouth of the bag. The steel cross-bow is of the ordinary description, of sufficient strength to throw the lead-bullet, with the cord attached, 120 feet high. When the house from which the persons in danger are to be extricated is so situated that the firemen can get to the roof by passing along the tops of the adjoining houses, they will carry up the chain-ladder with them, and drop it over the window where the inmates show themselves, fastening the hooks at the same time securely in the roof. The firemen will descend by the ladder into the window, and putting the persons to be removed into the bag, lower them down into the street by the single chain. If the flames are issuing from the windows below, the bag when filled is easily drawn aside into the window of the adjoining house by means of a guy or guide-rope. If the house on fire stand by itself, or if access cannot be had to the roof by means of the adjoining houses, the lead-bullet with the cord attached is thrown over the house by means of the cross-bow; to this cord a stronger one is attached, and drawn over the house by means of the former; a single chain is then attached and drawn over in like manner; and to this last is attached the chain-ladder, which, on being raised to the roof, the firemen ascend and proceed as before directed."

Southwark Iron Bridge—Construction of the Bearing Piers. From a descriptive account of the Principal Bridges erected over the River Thames: By Mr. Christ. Davy, Architect. [Continued from p. 9.]

The bearing piers of a bridge involve the consideration of many and widely-different circumstances, and by the construction of these vital adjuncts we are enabled in some measure to foretel the stability or insecurity of the architect's design.

A bearing pier (by which term it should be understood that those piers only are meant that are *in the river*) is generally a mass of solid masonry, built from the foundation to the level, or perhaps rather above the springing stone of the arch, and of sufficient weight to resist the attempts of the arch to overturn it, or to make it slide from its position. This force is called the thrust, push, or drift of the arch. Now, some means must be employed to determine, as near as possible, the force or weight requisite to resist the drift.



"We must," says Mr. Gwilt, "consider the thrust to be resisted by the friction, which the stones, composing the pier, experience, sliding on each other. From experiments, it has been found that in some kind of stone the friction of one block moving horizontally on another is equal to one-third of the weight of the moving block. If we adopt this determination, the weight of the pile ought to be equal to three times the horizontal drift to produce an equilibrium."

In addition to what Mr. Gwilt has here remarked, we must bear in mind that the piers must effectually withstand such extraneous shocks as are caused by the violence of the current, or from floating bodies. The salient angles of a pier, or cutwater, act as a preventive of the dangers likely to arise from these circumstances. In large navigable rivers, such as the Thames, the circular form sometimes given to the cutwaters is preferable, from the likelihood of their being struck by heavy craft, and its allowing them to disengage with greater facility. This form, however, does not divide the waters so well. In the earlier structures, we find, from the variety of proportions exhibited in the piers, that the subject had claimed attention; but mathematical investigation had not yet been brought in aid of the practical part of Pontile Architecture. The practice of piling for the support of such a cumbrous mass of materials as the bearing piers of a bridge has been most generally observed, and as generally found to be adequate for the purpose. But of the use and abuse of piling, it will be necessary to speak. The main use of piling being for the purpose of passing from a loose to a denser soil, it is necessary that that soil should be of such density as to prevent the piles from sinking farther than they are driven in the first instance by the pile engine. From the enormous load they bear, this is most likely to be the case, should the pointed ends or feet of the piles not rest on ground of great solidity. Indeed, it has been observed in my former papers, that piling is only a mode of *searching for firm ground*, where it is either inconvenient or too expensive to barrow out or excavate the soil. There are, however, some instances (such as a bed of stiff tenacious clay) where it has been found, by experiment, that although the feet of the piles rest upon no other security than that of the clay, a pile 10 or 20 feet long, driven down, will, by the friction

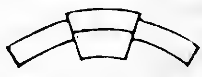
of its sides, have a hold of the ground nearly in proportion to its actual superficies.

It is evident, therefore, that piling, under two or three very different circumstances, may be made subservient to the effectual security of a foundation. The foundations of the bearing piers of Southwark Iron Bridge were laid in coffer-dams; but of a much larger and stronger description than those heretofore described. They were of an elliptical form, with a triple row of piles of whole timber. Each pier rests upon a massive timber platform supported by piles Close to the outer edge of the offsets of the pier, a row of timber sheeting-piles were driven, a precaution that at once exhibits the master mind of the late John Rennie. This uniform belt of timber forms, as it were, a close stationary dam, preventing the soft substratum upon which the piles rest from being pressed outwards by the weight of the pier: a circumstance that generally takes place where piling is employed, and the work heavy. This circumstance is also well known to miners, and is thus described by Mr. Seward:—"If a level be driven one or two hundred yards under ground through the solid rock, there will be no danger of its not continuing entire for an indefinite length of time; but if the sides and roof only of the level be formed in the rock, and the bottom be cut through into a bed or substratum of clay, however strong and stubborn it may be, being pressed by the weight of the super-incumbent rocks, it will imperceptibly swell and rise up in the level; and, unless it be continually pared down, or prevented by some means, the level will, in no great length of time, be entirely choked up." The masonry of the piers was carried up with horizontal and vertical bonds to the springing, where they radiated in wedge-like courses that received the line of direction, or force of the arch. (See the prefixed engraving.) The piers are 60 feet in height, from the bed of the river to the top of the parapet, and 24 feet in width.

[From the London Mechanics' Magazine.]

Mode of building a Dome without Centering.—I was glad to see the communication of "A Country Gentleman" in your Magazine, because such an inquiring spirit as your correspondent manifests, gives promise of a kindly feeling that may quicken and spread among the class to which he belongs, when it shall be found that those of that class who desire practical knowledge emerge from the folds of their seclusion, and seek it where it is most likely to be met with—among practical men. I was also gratified to prove the truth of my constant belief, that many gentlemen neglect inquiry at home, not from a lack of patriotic spirit, but from a notion that the required information can only be obtained abroad—being often struck by some apparent novelty, without being aware that it had grown stale in their native land.

I believe the method of building a dome without centering has been known to the English mechanics for a time longer gone by than can be traced with certainty. In fact, the process is so simple, that, although it might not have struck a theorist so immediately, a practical man could hardly have proceeded far in his work without being led into it. We will suppose such a practical man commencing a dome without any knowledge of the proper method to be pursued. He lays the first course of material at the spring of his intended dome, inclining a little inwards; he follows with a few more courses until he finds their inclination become too great to allow them support; he then, very naturally, endeavors to make his blocks *support themselves*; he tries various methods of accomplishing this, and cannot be long in hitting upon the best, from its very simplicity. Mere accident, perhaps, gives him the first idea of it; one block being left below the regular course, he will find another block upon this supported by the ends of the two adjoining and more elevated ones, in the manner here represented:



This will lead him to the more uniform and "solid" method of raising alternate courses, each block half its thickness higher than its neighbor: he thus will find he can build his dome up to its summit without centering.

For the purpose of showing this practically, I have made a model of a dome about three and a half inches diameter, formed of upwards of 150 pieces, which your correspondent may inspect if he will name a place to which it may be sent.

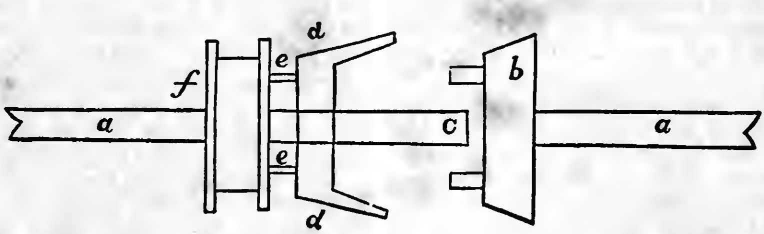
Yours, &c. Samuel Downing.
November 5, 1832.

[From the London Mechanics' Magazine.]

Friction Clutch-box, for adjusting the Connection between a constant going Wheel and intermitting Machinery.—Some years since machinery was put up in a building adjoining a mill which often wanted going and stopping. Being driven

by wheels with teeth, it was necessary, to prevent a fracture, that the water-wheel should be stopped. As this was found very inconvenient, after some thought, the following method was tried, and has answered ever since. Apprehending it might be useful in many cases, I take the liberty to request the insertion of this description of it in your Magazine. The machinery alluded to was driven by an iron square bar, and the improvement consisted in the introduction of a connector, which, in the absence of a better name, I shall call a friction clutch-box, which is different from any thing I have hitherto seen. The one-half of this box, with two studs, is fixed, as usual, at one end of the shaft to be connected, and the outer circumference is levelled about ⅛th of an inch in an inch long, forming part of a cone; and the other half of the box has a broad hoop fixed thereon, and standing forward like a cup, which, when pushed forward on the cone, gradually produces friction sufficient to set the maçhine a-going; and then there are two bolts previously drawn back, which are made to slide through this latter half box, and lay hold of the studs. The improvement will, however, be made clearer by reference to the annexed sketch.

a a represents the bar cut in two at *c*; *b*



the fixed half of the box, with the two studs fixed, and fixed on shaft; *d d* the other half of the box with hoop; *e e* two bolts fixed into *f*, and made to slide through *d*, far enough to grasp the studs in *b*.

As here represented, the bolts are withdrawn and out of work. Care must be taken that *f* with the bolts are not forced forward, until the motion is gained by pushing *d* on the cone.

N. B.—*d d* may have a groove as well as *f*, to put the lever into force backward and forward; and the end of the two bolts should be riveted enough to prevent their being withdrawn out of *d*; but they should be drawn back flush when disengaged.

W. S. S.

An account of some experiments made at Woolwich with Jones' Patent Iron Wheels. By Wm. Baddeley. [From the London Mechanics' Magazine.]

Sir,—In your 245th number, you have given an excellent description of Messrs. Theodore Jones & Co.'s patent wrought iron suspension wheels, and in No. 347, an account of a very successful experiment made with them at the opening of the stone tramway in the Commercial road. To these, I have now the pleasure of adding a description of some highly interesting and satisfactory experiments, that were made at the Royal Arsenal, Woolwich, in October last, under the superintendence of Major-General Hardwicke, and Lieutenant-Colonel Forrest, and in the presence of several officers of the Royal Artillery, to ascertain the fitness of the patent wheels for the general purposes of the Honorable East India Company's Ordnance Department in India.

In the first experiment, a pair of the patent wheels, five feet high, with six inch tire, were fitted to the carriage of an iron twenty-four pounder, weighing 50 cwt. 1 qr. 25 lbs.

Another pair of these wheels, five feet high, with three-inch tire, were fitted to the carriage of a brass twelve pounder, weighing 18 cwt. 5 lbs.

To each gun was attached its limber, furnished with the usual wooden wheels; the twenty-four pounder was drawn by six—the twelve pounder by four horses. The experiments commenced with briskly trotting, and sometimes sharply galloping the guns, over a very rough pavement, for upwards of an hour. The roughness and unevenness of the paving was so great, that the carriages bounded from stone to stone with great violence, sometimes springing a distance of several feet.

So great indeed was the violence with which the guns were galloped, that the rope lashings used to keep the guns in their places on the carriages were broken, and the twelve-pounder carriage was jerked completely off its limber.

On a close examination of the patent iron wheels, after they had been subjected to this

unusually severe trial, not the slightest appearance of injury was any where perceptible. The wooden wheels of the limbers, however, did not stand the shaking so well, although they had nothing but the weight of the empty limber boxes to carry; all the spokes were more or less started from their sockets; on measuring some of the openings, they were found to be three-sixteenths of an inch wide. Nor is this much to be wondered at, when it is considered that they were new wheels, which had been lying several years in store. This experiment fully demonstrated the extraordinary strength possessed by the patent wheels.

The second experiment had for its object, to ascertain the nature of the draught of these wheels upon *soft* ground. The twenty-four pounder, with a weight altogether of from four to five tons, and a draught of six horses, was attempted to be drawn over a piece of very soft marshy ground. The wheels sunk in too deep, however, for that number to draw them out; the poor horses were struggling and sinking up to their knees in the marsh, when two more were added; but, during the time that was occupied in attaching them, the wheels had sunk in to such a depth that it required the exertions of several men in addition, to start the carriage. This experiment was neither so satisfactory nor so fair as could have been wished; *ten* horses should have been attached in the first instance, and then the gun would have been drawn through the swamp without stopping.

By the regulations of his Majesty's service, eight horses are allowed for a twelve pounder, weighing about 18 cwt.; it ought not, therefore, to be expected that six horses should draw a load of 50 cwt. exclusive of the carriage, &c. through such a swamp as that in which this experiment was made.

In the next experiment, two twelve-pounders were drawn through the same marsh; one being mounted on Jones' patent wheels, the other on wooden wheels. Four horses (half the regular number) were attached to each; both passed through the marsh without stopping, but with great difficulty, the iron wheels appearing to have a slight advantage. The iron wheels, with six-inch tire, cut into the soft ground, which adhered to the inside of the rim; but the wheels with three-inch tire did not collect the earth in the same manner.

The twelve and twenty-four pounders were then ranged in battery in front of the butt, and three rounds, with full service charges (one shot each), were fired from both; no visible effect whatever was produced upon the wheels by the firing.

The final experiment consisted in ascertaining the comparative effects of a cannon ball upon the iron, and upon wooden wheels. For this purpose, one of the iron wheels was placed in front of the butt, and a twelve-pounder in the battery, at the distance of about two-and-thirty yards, brought to bear upon it. The first shot struck the wheel in an oblique direction, cut two of the spokes asunder as clean as if it had been done with a sharp cutting instrument, bending them both to one side, *but without any splintering.* The second shot was directed to the face of the rim, which it cut asunder, bending one end inwards; one spoke was also cut through —the nave grazed—one end of the nave box cracked—and a small piece cut off the opposite side of the rim. A wooden wheel was then placed in front of the butt, and submitted to the same rough treatment.

The first shot from the twelve pounder shattered two of the spokes, the splinters flying about very much. Shot the second struck the tire a little below the centre of the nave, which it shivered to pieces, the splinters flying in every direction, some of the fragments being thrown to a considerable distance. This wheel was completely "done for," and was incapable of being repaired; nor could it be rendered available for conveying the gun off the ground.

Not so the iron wheel; for, on the command being given to march home, though sadly mutilated, the wheel conveyed the gun a considerable distance.

The battery experiments, as detailed above, were most ably assisted by the exertions of Captain Rawnsley, of the Royal Artillery, who superintended laying the guns, which was done with an accuracy and effect hardly to be exceeded; and which, on the present occasion, contributed materially to the success and satisfactory nature of the experiments.

In a report made by Major-General Hardwicke and Lieutenant-Colonel Forrest, to the Court of Directors of the Honorable East India Company, they express their opinions of the merits of the patent wheels in the following words:

"From the foregoing experiments, it is but justice to the patentees of the iron wheels to record the advantages under which they appear.

"First, They are stronger, and not so easily disabled in action, and when struck with a cannon ball *do not splinter.*

"Secondly, When they sustain an injury

to the extent of two or three spokes broken, the wheel might be continued in use till an opportunity occurred of repairing it, while a wooden wheel under similar circumstances would, for the time, be unserviceable.

"Thirdly, The iron wheels are not subject to those changes which influence of climate and changes of seasons work on wood wheels. We have seen in the course of these experiments, that new wheels that have lain a few years in store, would require to be set up before sent on service. No length of time can render this necessary with the wrought-iron wheels."

Any comment upon the foregoing is quite unnecessary.

Smoky Chimneys. By R. [From the London Mechanics' Magazine.]

I have not for some time read any thing with greater pleasure than the judicious remarks of C. D. S.

An association of architects for the purpose which he suggests, commencing on scientific principles, would, doubtless, have but little difficulty in devising objects more sightly than, and equally efficient with, those at present in use for the cure of smoky chimneys.

All those who have any pretensions to order and taste, must, in common with your correspondent, have felt disgusted with the general means employed to eradicate the evil in question; and every one who loves to breathe the pure air, and knows the value of it, should do his utmost to forward the suggestions alluded to, as the result would not only be highly gratifying to those who can appreciate the beauty of judicious architectural forms, but also beneficial to those who have no just conceptions of the value of untainted air.

In the present enlightened and inquiring age, we must not, however, rest satisfied with merely ascertaining in what way the annoyance can be got rid of; but we must also know the fundamental cause of the existing evil, as well as sufficient reasons why a chimney-pot is calculated to effect a cure. This is the true way to proceed to arrive at a favorable conclusion; and unless a society start upon those principles their labor will prove unsatisfactory.

It may be said, that "the means and experiments employed to effect a cure will at the same time disclose the cause;" but this may not be the case. Indeed, to know the cause of the good or evil we daily experience, is a point, I am sorry to say, that we trouble ourselves very little about. We know from experience that certain agents produce certain effects; so we generally take things for granted, without ever inquiring into the nature of the operation. The bricklayer puts up a chimney-pot to cure a smoky flue, upon the same principle that the apothecary's patient swallows physic, in hopes of a certain result; namely, because they know that the same means had in former cases produced the effects they now wished for. But we must know the "why" and the "wherefore," before we can be said to know much about the matter.

In recommending the foregoing as the fundamental principles to be observed by a society for the laudable purpose that your correspondent suggests, I shall here subjoin my own humble opinions on the matter of smoky chimneys; which I do with due deference to those who have had more experience, and paid more attention to the subject, than myself.

To define the particular cause of a smoky chimney, unless some individual cause were pointed out, is utterly impossible. We all know that the best constructed flues are liable to smoke occasionally in bad weather, when the density of the atmosphere is less than in fine weather; the reason is, that when the specific gravity of the atmosphere is reduced and approaches nearer to that of smoke, the latter cannot ascend so freely; because the weightier the atmosphere the more rapid is the ascent of the smoke, on the same principle that a current of water passes an impediment with greater velocity than where it has no obstruction. This cause, however, seldom occurs, which is as well, as we can never overcome it: the chief causes are the following—

Flues that are not properly *drawn in* immediately above the fire-place, are liable to smoke; because a wide opening may contain more air than the fire can properly rarify; which, therefore, passes on to join the air of the room, carrying the smoke with it; while, on the other hand, flues that are narrow at the throat not only obviate this, but a smaller cavity opening into a wider one creates, of course, a greater current. Chimneys which are built in sheltered situations are liable to smoke for want of a free circulation of air round the chimney tops: this, however, I shall presently explain more fully. Flues that are not properly pargeted or plastered inside, are also liable to smoke; because the air penetrates through the porous nature of the bricks, as well as between them when the mortar is decomposed. Square

or parallelogram flues are very bad forms; because smoke always ascends in a circular column, and therefore the angles of these forms serve as receptacles for cold air. When the divisions between the flues are very thin, the consequence is also bad; because, occasionally, the chimney of the next flue may have no fire on, and, therefore, the cold air penetrates through the thin divisions. The preceding deficiencies, with other topical circumstances, may be considered the chief cause of smoky chimneys.

A chimney that smokes from any of the foregoing defects, or from any other cause whatever, and is cured by a chimney pot, would, in the event of the chimney pot being removed, and the stack of chimneys carried up in a body, even as high as the loftiest "tall-boy," again return to smoking; because, it is not the additional height that effects the cure, but the freer circulation of air round the openings of the flues. When a number of flues are built in one chimney stack, as is the case with street houses at present, it is obvious that a current of wind (which generally passes in a horizontal direction,) when interrupted by a broad mass of building, rises perpendicularly to the top of the impediment, and then resumes its horizontal direction; so that, in passing over the flues, it not only prevents the free exsurgence of the smoke, but frequently finds its way down into the flues. The chimney-pots, on the other hand, divide the current of the wind, which has a free passage between them. Since, therefore, chimney-pots cannot be avoided in certain situations, and with certain connected circumstances, it behooves architects to devise proper architectural forms, suitable for the buildings to which they may be applied, to supersede the disagreeably-colored and unshapely forms at present in use.

I intended to send you along with this, outlines of forms for chimneys, characteristic of the different styles of architecture; but not knowing how far they might be agreeable to the plan of your work, I have deferred it for the present.

In conclusion.—Well constructed *circular* flues, with *sweet* windings or turns, well drawn in at the throat, and properly pargeted or plastered, brought together as much as possible for the sake of heat, and carried up in one body to the roof, placed in the internal walls, the chimneys carried up to a moderate height above the roof, with openings between the shafts, the coping bevelled outwards to serve the double purpose of throwing off the rain, and conducting upward the transit of the smoke,—will scarcely fail to vent well in any situation.

Bayswater, August 20, 1832.

Railroads for Private Use. [From the American Railroad Journal, &c.]

The force of traction necessary to propel a ton's weight on a level road is eight pounds. To propel the weight of an ordinary human body, or 140 pounds, would require at this rate just half a pound. As easily, then, as such a person could walk up several flight of stairs to the height of thirty-two feet, he could move his own weight upon a level railroad one mile and three-quarters; and if we include a light carriage of 140 pounds, he could move himself and his carriage three-fourths of a mile as easily as he could walk up stairs 32 feet. The ease with which persons can walk on level ground, or a floor, is an argument for level roads, which many must sensibly feel; but, whatever be the ease with which persons can walk on level ground, they cannot move forward with great rapidity, nor without some fatigue; but a wheel is not put out of breath, and a friction on the axle, of a few inches, carries it forward several feet. For innumerable occasions this facility of moving would be exceedingly convenient in a vast variety of lines of communication, where large railroads for steam or horse power could not be supported. There are innumerable occasions on which families in the country wish to convey articles a few miles to a store, which they cannot carry in their hands, and which are not a load for a horse. In these cases it would be very easy for a man, or even a woman, to take a beautiful fancy rail-car, of 140 pounds weight, and take a load of 200 pounds weight, and go on a dry rail, when a common road is deep with mud, some four or five miles to a store. In this case no more effort would be necessary than would be required to raise up over a pulley a weight of one pound and two-thirds. It would require no more force to move through the whole four miles, the carriage of 140 pounds, the load of 200 pounds, and the person of 140 pounds—in all 480—than for the person of 140 pounds to walk ten times up a flight of stairs of 26 feet in height.

PUBLICOLA.

Improved Method of Aquatinta Engraving. By MECHANICUS. To the Editor of the Mechanics' Magazine and Register of Inventions and Improvements.

SIR,—If the following short account of the method of effecting aquatinta engraving

is thought worthy of a place in your valuable publication, it is at your service.

After the intended figure is outlined, by etching or otherwise, the plate is covered all over with a ground of rosin, Burgundy pitch, or mastic, dissolved in rectified spirits of wine; this is done by holding the plate in an inclined position, and pouring the above composition over it. The spirit of wine almost immediately evaporates, and leaves the resinous substance in a granulated state, equally dissolved over every part. The granulations thus produced, if examined through a magnifying glass, will be found extremely regular and beautiful. When the particles are extremely minute and near to each other, the impression from the plate appears to the naked eye exactly like a wash of Indian ink; but when they are larger, the granulations appear more distinct. This powder or granulation is called the aquatinta grain. The plate is next heated to make the powder adhere; and in those parts where a very strong shade is wanted, it is scraped away; but where strong lights are wanted, a varnish is applied. The aqua fortis, properly diluted with water, is then put on with a piece of wax, as in common etching or engraving; and by repeated applications of this process, scraping where darker shades are required, and covering the light parts with varnish, the final effect is produced.

Engraving by aquatinta was invented by Le Prince, a French artist, by whom the process was long kept secret. It is even said that for some time he sold his prints, (which are still reckoned excellent specimens,) for drawings.

Sub-Marine Adventurers. By J. Elliott.

[From the London Mech. Magazine.]

Sir,—From a paragraph, in the newspapers, it appears that Mr. Dean, the diver, is now at Spithead, engaged in recovering property from a vessel wrecked there some years ago. Mr. Dean is the same person who descended to the bottom of the River Thames on the 5th of December last, from a barge moored near the centre arch of Southwark Bridge. At high water the diver made his appearance habited in a sort of canvass dress, having a coil of tubing round his body, and a sort of helmet on his head; about his middle were affixed weights to enable him to sink easily. A rope being made fast round his body, he descended a ladder fixed at the head of the barge, and went to the bottom of the river, and remained under water at least 4½ minutes; he then came up the ladder and delivered something he had taken from the bed of the river to the people in the barge. He next again descended, and remained under 9½ minutes; he then came on board the barge and divested himself of the whole of the apparatus in a few minutes.

I believe Mr. Dean's contrivance is something similar to an apparatus patented a few years ago by a correspondent of the Mechanics' Magazine, Mr. Steele, of Magdalen College, Cambridge.

In the month of January, 1828, I was on board the Bell Lighter, moored over the Thames Tunnel, when Mr. Gravatt, the engineer, descended. He was under water nearly an hour, and the weather was exceedingly cold, yet I observed that when he came out of the bell he seemed to be in a profuse perspiration; a circumstance which confirms, in some measure, the experimental observations of Mr. Milne, as detailed in Number 471.

At the time of the first irruption of water into the Tunnel, Mr. Faraday descended in the bell with Mr. Brunel, jun.; and in a Lecture at the Royal Institution, Mr. F. stated a remarkable fact, that Mr. Brunel, when he dived under water from the bell into the Tunnel, was able to remain full *two minutes* under water without experiencing any great inconvenience. He accounted for the fact in this way: when the bell was lowered to the greatest depth (about 15 feet) the air inside was necessarily much compressed; the persons in it, therefore, though they inhaled the same *bulk* of air which they would under other circumstances, yet as two atmospheres were compressed into one, inhaled twice the *quantity*, and of course a much larger supply of oxygen was furnished to the lungs. Yours, &c. J. Elliott.

We subjoin an account extracted from the Norwich Mercury, of the exploits of another diving adventurer of the name of Bell, which are in most respects similar to those of Dean, but distinguished by one or two novel circumstances.—[Ed. M. M.]

Mr. Bell's Operations.—"There is a small cutter now lying in our (Yarmouth) roadstead, belonging to a man named Bell. Her crew consists of six men, several of whom are singularly expert in diving. She sails about from place to place, to offer assistance to recover lost treasure, &c. She has arrived for the purpose (by permission of the Admiralty) of endeavoring to obtain a portion of the treasure lost in the Guernsey Lily transport, which got on the Cross Sand, floated off, and afterwards foundered in the centre of Yarmouth roads, in 43 feet water, coming with stores, &c. from Holland, after

the Duke of York's expedition in 1799. The transport was laden with horses, ammunition (in which were 25 brass field pieces), a stock of wine, &c. The method these divers use is curious:—The cutter is first placed immediately over the wreck, the diver then, habited in an India-rubber air-tight dress, having a tube attached at the back of the neck to receive the air (which is constantly kept pumping in), descends from a rope ladder, and gives signals for certain things to be sent down by a small line, which is attended to by those on the deck of the cutter; by this line baskets and other utensils are sent down for the use of the diver, and sent up again with wine, &c. taken from the wreck. The diver's head-dress is curious: it is composed of copper, and is a complete covering, much after the manner of the ancient helmet, only that it is made larger than the head, and has in its upper part three glass windows; it weighs 50 lbs. He has two other dresses on besides that above-mentioned. He carries down with him 120 lbs. of lead in two bags. With all this weight he declares that when in the water he appears perfectly free from weight or incumbrance of any sort. There has been already brought up a large quantity of wine (the bottles curiously tattooed with large and small oysters, which have been tasted, and are excellent), some copper, iron handles of chests, pieces of gun carriages, &c. They hope soon to be in possession of the brass guns, valuable plate, and the dollars which it was known the transport had on board for the purpose of paying the troops employed in the above-mentioned expedition. The Admiralty, we understand, has handsomely given permission to Captain Bell to make what use he pleases of the articles found, only conditioning that the brass guns, if recovered, shall be given up, for which they will return value. Great numbers of persons from different parts of the country have been off to view this novel and singular undertaking. The diver, when under water, finds his strength so increased, that he can bend the ends together of the large iron crowbar ($3\frac{1}{2}$ feet long and $9\frac{1}{2}$ inches in size) which he takes down with him to part the wreck. These divers go down alternately about twice a-day, but are compelled to take advantage of the tides, when it is slack water."

Braithwaite's Steam Fire-Engine. [From the London Mechanics' Magazine.]

We witnessed a very gratifying display of the powers of this engine at the great fire at Messrs. Barclay and Company's Brewery, on Tuesday last. The fire broke out about five o'clock in the afternoon, but, unfortunately, more than three hours were suffered to elapse before the steam fire-engine was sent for, and as it had then to come from a distance of four miles, it was near ten o'clock before it was brought into play. When we reached the scene of the conflagration, which was shortly after eleven o'clock, we found the engine in full operation, under the direction of Messrs. Sidney and Septimus Braithwaite, and Mr. Milner, jun. From that time till five o'clock in the morning we saw it in constant work; ejecting between thirty and forty tons of water an hour, and to heights, as occasion required, not much short of 100 feet. Mr. John Braithwaite joined the forces of the "Steam King" in the course of the night, and greatly distinguished himself by the spirit and intrepidity with which he personally directed the stream of water on the most dangerous parts of the burning pile. We saw also some of the ordinary engines very well worked, the Guardian in particular; but by the time the steam fire-engine came into the field, the firemen of all the others had been greatly exhausted, by several hours' hard working during the worst period of the conflagration. One of the strongest recommendations of the steam fire-engine is, that when once set to work it *never tires.* We were informed by one of the partners in the brewery that the Norwich Company's engine had in the early part of the evening distinguished itself beyond all the other engines, by the vigor with which it attacked some of the loftiest parts of the premises. The manner in which the fire originated may furnish a useful lesson to all persons who have occasion to introduce lights into apartments where there are ignitible particles floating about. A workman was proceeding with an open lamp in his hand to grease a part of the machinery called Jacob's Ladder, when the dry malt-dust, with which the atmosphere of the place was impregnated, caught fire, and spread so rapidly and irresistibly, that within an hour the whole of the working part of the brewery was in flames. The damage is estimated at about £50,000.

On the Formation of Waves—their altitude, breadth, and time of undulation. By Juvenis. To the Editor of the American Mechanics' Magazine, and Register of Inventions and Improvements.

When the surface of water is unequally pressed on, in parts contiguous to one another, the columns most pressed on are shortened, and sink beneath the natural level of the

surface, while those that are least pressed on are lengthened, and rise above that level.

As soon as the former columns have sunk to a certain depth, and the latter have risen to a certain height, their motions are reversed, and continue so till the columns that were at first most depressed have become most elevated, and those that were most elevated have become most depressed.

The alternate elevations and depressions thus produced are called *waves*.

The water in the formation of waves has a vibratory or reciprocating motion, both in a horizontal and a vertical direction, by which it passes from the columns that are shortened to those that are lengthened, and returns again in the opposite direction, progressive motion not being necessary to undulation.

The vibrations of water in the form of waves may be compared to the reciprocations of the same fluid in a syphon or bent tube; and it was from this that Newton deduced the velocity of waves, and the time required for an undulation.

The *time* of an undulation is the time from the wave being highest, at any point, to its being highest at that point again. The *velocity* of the wave is the rate at which the points of greatest elevation or depression seem to change their places.

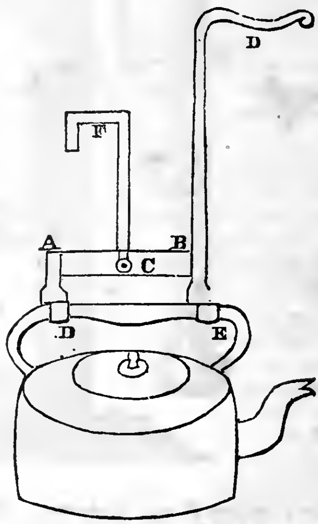
If the altitude and breadth of a wave be known, the time of an undulation and the space which the wave appears to pass over may be determined as follows:—To find the *time* of an undulation, add half the breadth of the wave to its altitude, multiply the sum by ·3927, and the square root of the product will be the time in seconds. (This number is one-eighth of the circumference of a circle whose diameter is 1.) Thus, suppose the breadth of a wave to be 14 feet, and its heighth 3 feet, required the time of an undulation. Here the sum of the height and half the breadth is 10, which multiplied by ·3927, becomes 3·927, the square root of which is 2, nearly, the number of seconds in which an undulation is performed.

To find the *space* which the wave passes over in one second:—Divide half the breadth of the wave by the square root of the altitude, and half the breadth, multiplied by 3·927, and the result will be the space passed over by the wave in one second.

Thus, suppose the breadth and height of a wave to be as stated in the preceding example, and it is required to find the space it will pass over in a second of time. Here the square root of 10 is 3·1, nearly, which multiplied by ·3927 is 1·22, nearly; and 7 divided by this number quotes $5\frac{3}{4}$, nearly, which is the space passed over in one second.

While the depth of the water is sufficient to allow the oscillation to proceed undisturbed, the waves have no progressive motion, and are kept, each in its place, by the action of the waves that surround it. But if by a rock rising near the surface, or by the shelving of the shore, the oscillation is prevented, or much retarded, the waves in the deep water are not balanced by those in the shallower, and therefore acquire a progressive motion in this last direction, and form *breakers*. Hence it is that waves always break against the shore, whatever be the direction of the wind.

Breakers formed over a great extent of shore are distinguished by the name of *surf*. The surf is greatest in those parts of the earth where the wind blows always nearly in the same direction; but in the foregoing observations no allowance is made for winds.

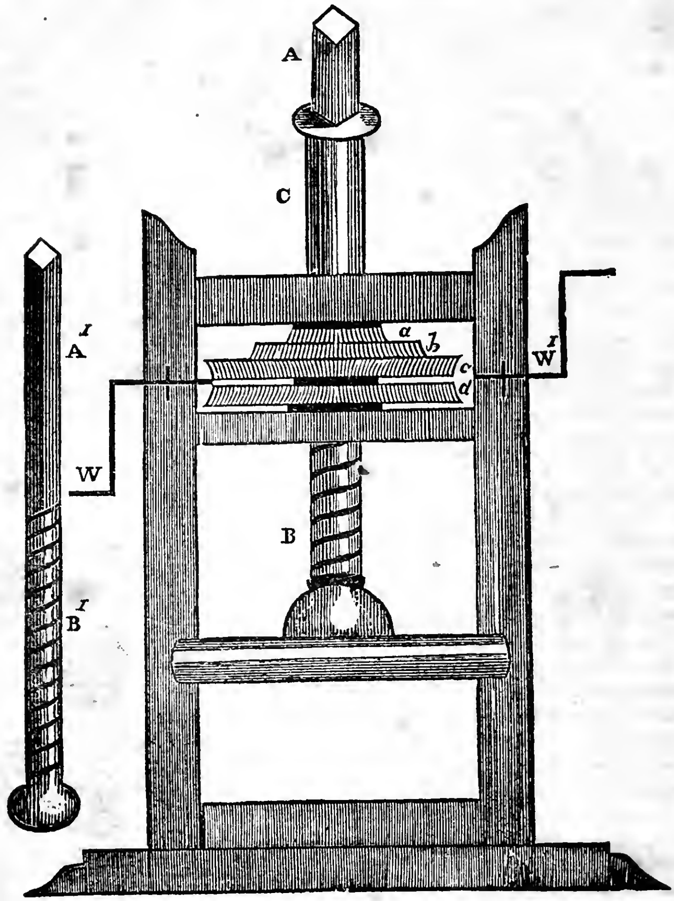


Improved Kettle-Holder. By G. J. [From the London Mechanics' Magazine.]

Sir,—A B is a slender bar of iron, or strong piece of hooping. A D, B E, are hooks of equal size fixed at A and B; but E B is prolonged upwards to D, where it is turned off square to form a handle. F is a hook, admitting of being turned freely round its centre-pin C. The hook F is hung on across the pot-hook, and the kettle on the hooks D E; there is also a spring, which is welded on A B, and entering the mouth of the hook E, prevents the kettle from slipping. The operation, then, is to draw the handle D towards you, when the water will

be steadily discharged without giving you any chance of scalding or burning your fingers. The contrivance is so simple and cheap that I have no doubt any blacksmith would make it for two or three shillings.

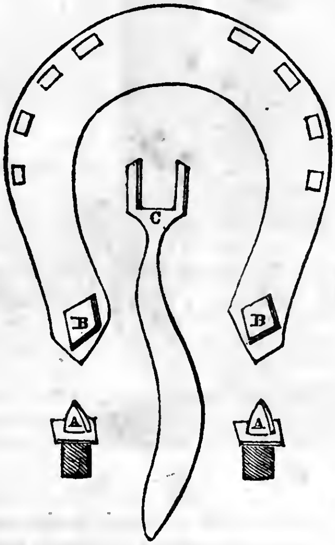
It will at once appear, Mr. Editor, that this is an useful kitchen utensil, and as such I feel assured that its description will not be denied a place in the pages of the Mechanics' Magazine.



Hunter's Screw Press Improved. By Φ. M.
[From the London Mechanics' Magazine.]

Sir,—I beg leave to submit to the consideration of your readers the following design for extending the range of an admirable invention, which must be familiar to most of them—I mean Hunter's Screw Press. My principle is, instead of using Hunter's triple combination of nut and screw, to use only a nut and screw with a supplementary apparatus, which shall have the effect of making the screw, as it were, run away from the grip, of the nut, while the nut is made to follow with whatever degree of velocity may be required. Thus the screw rises with a velocity bearing a similar ratio to that of the moving power, as in Hunter's, while the range of the resultant power is continued through the whole length of the screw. In the accompanying figure, A′ B′ is the screw taken out of its place; a square projection of equal length with the screw is added to it. The head of this square part is seen in the figure at A, rising out of C, in which it slides. C is a tube with a circular bore, wide enough to admit the screw freely, but closed by a square aperture, through which the square projection works. C is of one piece with *a*, *b*, and *c*, and works resting upon *d*, which is the real nut. *a*, *b*, *c*, and *d*, are furnished with teeth, and a winch is affixed by a contrivance which will allow of its engaging either *a*, *b*, *c*, or *d*, individually, or *c* and *d* together. *a* may be supposed to

have 50 teeth, *b* 100, *c* 200, and *d* 200. *a*, *b*, and *c*, are intended merely to bring the screw down to its work, or to perform light tasks; and when the winch engages any one of them, *d* is clamped. When the screw is required to do its utmost, the winch is made to engage *c* and *d* together: then *c*, by means of its hold on the square projection, keeps the screw going before the nut, while the nut is overtaking it at the rate of one tooth for each revolution. The construction given in the figure is one of several, and not the best, but the one I found least troublesome to copy. I hope some of your correspondents will favor us with an opinion of the merits of the machine as thus altered, and also with a calculation of its powers, taking for data the winch at 15 inches radius, the moving power at 30 pounds, as also, that one revolution of the winch passes one tooth, and that one revolution of the nut *d* passes one thread of the screw, the interval between any two threads being 2 inches.



Improved Horse Shoe. By T. P. [From the Voice of Humanity.]

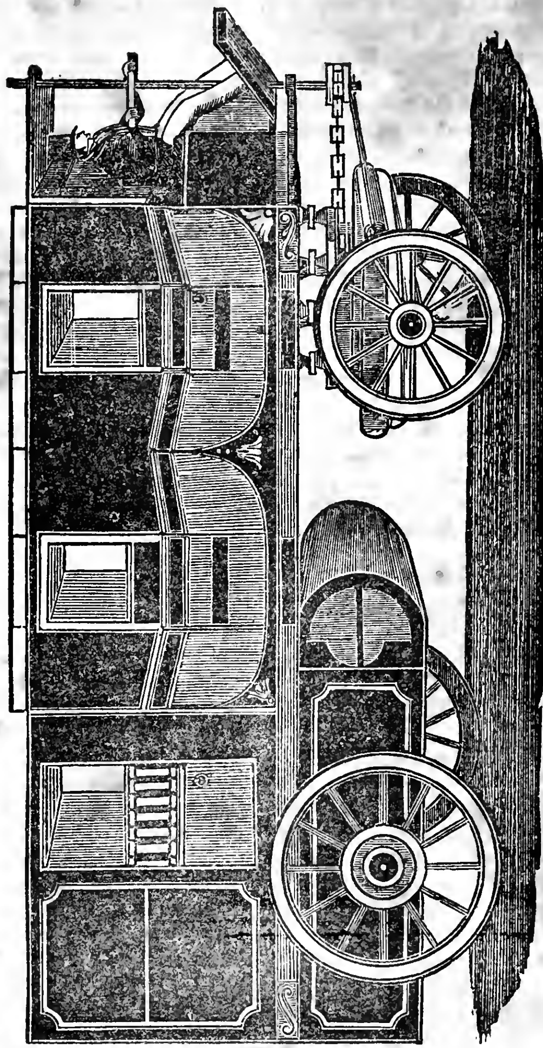
Sir,—I was lately travelling in a coach, early in the morning: it was one of those mornings which are so distressing to smooth-shod horses. In the night there had been a considerable fall of sleet, with a little rain, aad this fall was immediately followed by a very hard frost, so that the road was one complete sheet of ice. Coming on so suddenly, there was no time to get the horses rough-shod, and their consequent suffering was great. They were down and up, first one and then another, all the way. In order to get up one little hill, all the passengers were asked to get out and off from the coach, and even then it was with the greatest difficulty that the coachman could force the horses up. He was obliged to "lash them into madness;" sometimes two were down together, and once all four were down at the same time, and when they had scrambled to the top they were in a pitiable state of exhaustion, the sweat literally running from them as though warm water had been poured on their backs, although so cold a morning.

It struck me at the time that it would be easy to make horse shoes which might be turned up, as it is termed, in a few minutes. I send to your appropriate publication a drawing of the sort of shoe I have invented.

The two steel nuts, marked B, are made barely a quarter of an inch high, about one-eighth and a half, and wore in the winter when the roads are not slippery. When the frost comes, and you wish the horse turned up, or more properly speaking, rough-shod, you take out the two nuts, marked B, by means of the spanner, marked C, and put in the two steel nuts marked A. The whole is done in a few minutes. Mr. Holmes, the veterinary surgeon of this town, has lately shod some horses in this way, and it answers well. When the groom or ostler picks his horses' feet every night, he should at the same time take out the nuts, put a little oil or grease to them, and screw them in again tightly: this is to prevent their getting fastened by rust. There should always be a little store of nuts, that as they wear down they may be replaced; and they must not be permitted to wear down lower than that state in which they can be turned out by the spanner. The prevention of the very injurious effects upon the feet of horses by their shoes being taken off and turned up (often required from frost in a day or two after they have been newly shod) is worth consideration, to say nothing of its being done in haste and the foot often pricked.

Above all this, rational humanity and kindness to those docile, useful, and noble animals, should be our main object. Let them ever be considered as gifts from the Almighty Creator, for our use and comfort, and let them ever be treated with gentleness. Indeed, I believe they are seldom ill-treated, but by men of vulgar minds, unthinking, or uneducated; or if educated, their education not based on Christian principles, and, without that base, I hold all education defective, if not mischievous.

Birmingham, Feb. 9, 1832.



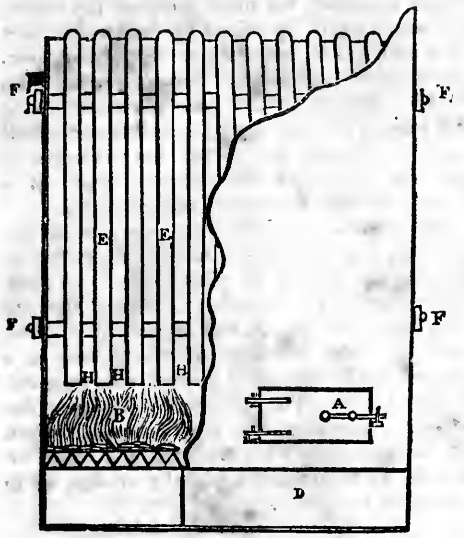
[From the London Mechanics' Magazine.]

Walter Hancock's Steam Carriage.—The engraving, above delineated, represents a new steam carriage, which Mr. Walter Hancock has just built to run on the road between London and Greenwich. For the following particulars of its construction we are indebted to Mr. Gordon's valuable Historical and Practical Treatise, reviewed in our last number.

There are two engines, which are placed before the boiler, and turned with the stuffing box down, so that the cylinders are uppermost, and the piston and connecting rods below. The crank shaft with two cranks is supported by a flexible frame, which provides for any concussion on rough roads. A chain passes over a sheave on the crank shaft, and over a larger sheave on the hind axletree. The wheels turn loose on the axle, and one or other, or both, are fixed by a clutch when required. This clutch is on the outside of the wheel, and can be screwed out or in, as the case demands, with great facility. The turning of the carriage round to the offside is prepared for by throwing out the offside clutch and keeping in the near one; and the turn round to the near side is prepared for by throwing out the near clutch, and throwing in the offside clutch. A little play is left between the catches in each clutch, so that a winding road may not oblige either

wheel to be disengaged; and it is only in a short turn, or a turn round, that the clutch must be shifted, and this can be done in a very small space of time.

The engraving annexed represents an elevation of the boiler, with part of the casing removed, for the purpose of exhibiting the interior structure. A is one of the fire doors,



of which there are two. B the fire-place; D the stoke-hole; E E the chambers, constructed of the best wrought iron; F F shows the manner in which all the chambers are bolted together, so as to form a large boiler of many compartments. There are fillets of iron, which keep the individual compartments at a proper distance from each other; and the spaces which these fillets leave are the flues of the boiler, through which the flames ascend, as shown at H H H. All these compartments are connected at the bottom for the purpose of keeping the water in each at the proper level; and at the top the steam is conveyed from each by as many pipes as there are chambers, into the steam feed-pipe, by which steam is conveyed to the engines. By this arrangement the only parts of the boiler which can be dreaded are the sides, but good ties will keep them together. And as to the bottom end and top of the boiler, which are composed of the edges of these compartments, if one part is burnt out or hurt, it is only that individual compartment which can burst, and its power of doing mischief is not worth notice. The fire is urged by a blower which is driven by a connection with the engines. The waste steam is blown from the engines into the chimney, and so destroyed.

The passengers are carried on the same machine, Mr. Hancock preferring that disposal of the weight to the dragging of it in a carriage behind. The wheels of the carriage are a beautiful exhibition of strength and lightness combined. The spokes are all wedge-shaped, and where they are fastened into the nave abut against each other. Their escape laterally is prevented by a large iron disc at each end of the nave; and these being bolted through, confine the spokes securely in their place.

On the Strength of Men and Animals. [Selected for the Mechanics' Magazine.]

The form and construction of the human body renders it peculiarly applicable as the first mover of machinery, and what it wants in strength is compensated in a great degree by the skill and judgment with which it can be applied. When we consider the great number of cases in which it is preferable to employ the action of men rather than that of inanimate agents, and the still greater number in which it is out of our power to employ any other, it becomes a matter of the highest importance, both to workmen and to those who employ them, to ascertain the way in which the greatest quantity of work can be obtained from their exertions, with the least quantity of bodily fatigue, or with such a quantity of fatigue as they can easily bear from day to day, without injuring their corporeal functions.

Daniel Bernoulli, indeed, maintained that the degree of fatigue is always proportional to the quantity of action by which it is produced; that, whether he walks or carries a load, or draws, or pushes, or works at a winch, or raises a weight, he will always produce, with the same degree of fatigue, the same quantity of action, and therefore the same effect; and that the daily labor of a man, whatever be the work to which he is set, may be reckoned at 1,728,000 pounds, raised through the height of one foot, or 60 pounds raised through the height of one foot in a second, when his day's labor amounts to eight hours. These opinions were adopted by almost all subsequent authors, on the authority of vague and inconclusive experiments, till the subject received a full investigation from the celebrated Coulomb, Amontons, and others.

According to M. Amontons, a man weighing 133 French pounds, ascended 62 French feet by steps in a minute. but was completely exhausted.

A sawyer, according to the same author, made 200 strokes of 18 French inches each, with a force of 25 pounds, in 145 seconds.

An ordinary man, according to Desaguliers, can turn a winch with the force of 30 pounds for 10 hours, with a velocity of $2\frac{1}{2}$ feet per second.

Two men, according to Desaguliers, working at a windlass with handles at right angles to each other, can raise 70 pounds more easily than one man can raise 30, an additional effect of five pounds being produced on the work of each man in consequence of the uniform action arising from the handles being at right angles to each other.

A man may, according to the same author, exert a force of 80 pounds with a fly, when the motion is pretty quick.

A man may, also, with a good pump, raise a hogshead of water 10 feet high in a minute, and continue the work for a whole day.

According to Dr. Robinson, a feeble old man raised 7 cubic feet of water, equal to $437\frac{1}{2}$ pounds avoirdupoise, $11\frac{1}{2}$ feet high, in a minute, for 8 or 10 hours a day, by walking backwards and forwards on a lever.

A young man, weighing 135 pounds, and carrying 30 pounds, raised $9\frac{1}{4}$ cubic feet of water, equal to 578 $\frac{1}{10}$ avoirdupoise, $11\frac{1}{2}$ feet high, for 10 hours a day, without being fatigued.

The strength of men and of all animals is most powerful when directed against a resistance that is at rest: when the resistance is overcome, and when the animal is in motion, its force is diminished; lastly, with a certain velocity, the animal can do no work, and can only keep up the motion of its own body.

The effect of animal force, or the quantity of work done in a given time by any working animal, is greatest when the animal moves with one third of the speed with which it is able only to move itself, and is loaded with four-ninths of the greatest load it is able to put in motion.

According to this estimate, a man who can move 120 pounds, and walk at the rate of 4 miles an hour, when working to the greatest advantage, should carry a load of 54 pounds, and walk at the rate of two feet in a second, or a mile and one-third in an hour.

In raising a weight, a man will produce the greatest effect when his weight is to that of his load as 4 to 3 nearly.

When a horse's work is estimated by the load he draws in a cart or waggon, a great reduction must be made, in order to compare the force he exerts with that which is necessary for raising a weight, by drawing it over a pulley. Though accurate experiments on the friction of wheel carriages are wanting, we probably shall not err much in supposing the friction on a road, and with a carriage of the ordinary construction, to amount to a twelfth part of the load. If, then, a horse draws a ton in a cart, which a strong horse will continue to do for several hours together, we must suppose his action the same as if he raised up the twelfth part of a ton, (2240 pounds,) or 186 pounds perpendicularly against the force of gravity. To raise a weight of 186 pounds, therefore, at the rate of two miles, or two miles and a half an hour, (that is, 2·9, or 3·6 feet per second,) may be taken as the average work of a strong draught horse in good condition.

On this subject, however, many more experiments are wanting: to determine, for instance, the friction of wheel carriages; the difference of the exertion required to walk on a horizontal plane, and on one of a given declivity; the quantity of work done in a given time by the same animal, carrying different loads. The difference between the effective exertion of a man's strength when he moves along with his load, and when he stands, as in turning a wheel; or sits, as in rowing a boat, &c.

Marquis of Worcester's Century of Inventions.—It has been suggested to us by an intelligent friend, that the republication, in our pages, of the Marquis of Worcester's celebrated Century of Inventions would render a valuable service to science, by making it more generally known to the mass of the community, and obtaining for it, in particular, more of the consideration of practical men than it has hitherto received. We have been favored with a correct transcript of a copy of the work, which has been collated with a copy in the hand writing of the noble author himself, preserved in the Harleian MSS. at the British Museum, vol. 2428, and now present it to our readers entire. From the readings in the foot notes, which are those of the MS., it will be seen that the variations between the two authorities are mostly immaterial. In one instance, however, (No. 88,) the MS. has substituted quite a different invention from that in the printed copy, and one which is credible enough, while the other beggars all conception. We propose, also, in the ensuing number, to publish some original notes from the pen of Robert Stuart, Esq. author of the History of Steam Engines, and illustrative of the Marquis' invention.

The Marquis's Century of Inventions, which we are now to lay before our readers, was first printed in 12mo. in 1683. Walpole is pleased to designate it as an "amazing piece of folly;" but later and better informed writers have been led to think differently of it. Granger remarks—"That a practical mathematician, who has quickness to seize a hint, and sagacity to apply it, might avail himself greatly of these scantlings, though little more than a bare catalogue." And the same writer was informed by the late reverend and ingenious mechanic, Mr. Gainsborough, of Henley, brother to the celebrated painter, that the Marquis's work was far from being such a collection of whims and chimeras as it has been supposed to be, and that, on the contrary, "he highly esteemed the author as one of the greatest mechanical geniuses that ever appeared in the world." It is quite certain, too, that since his time several of his "inventions" or suggestions have been reduced to practice; and hence the whole have become entitled to be treated with more respect. Professor Robison goes so far even as to affirm that the steam engine, the greatest discovery of modern times, "was, beyond all doubt, invented by the Marquis;" and though later researches have shown that this is somewhat unmerited praise, it is evident that he entertained views of the applicability of steam as a moving power, such as no other individual of the age in which he lived had the sagacity to embrace.

The "book" which he promises at the conclusion of the Century to leave to posterity, showing "the means to put in execution and visible trial all and every of these inventions, with the shape and form of all things belonging to them,—printed by brass plates," he did not live to execute.

To the King's Most Excellent Majesty:

Sir,—"*Scire meum nihil est, nisi me scire hoc sciat alter,*" saith the poet, and I must justly, in order to your Majesty, whose satisfaction is my happiness, and whom to serve is my only aim, placing therein my *summum bonum* in this world: be therefore pleased to cast your gracious eye over this summary collection, and then to pick and choose. I confess I made it but for the superficial satisfaction of a friend's curiosity, according as it is set down; and if it might now serve to give aim to your Majesty how to make use of my poor endeavors, it would crown my thoughts, who am neither covetous nor ambitious, but of deserving your Majesty's favor, upon my own cost and charges; yet according to the old English proverb, "It is a poor dog not worth whistling after." Let but your Majesty approve, and I will effectually perform to the height of my understanding: vouchsafe but to command, and with my life and fortune I shall cheerfully obey, and, *maugre* envy, ignorance, and malice, ever appear your Majesty's passionately devoted, or, otherwise, disinterested subject and servant,

Worcester.

To the Right Honorable the Lords Spiritual and Temporal, and to the Knights, Citizens, and Burgesses of the Honorable House of Commons, now assembled in Parliament:

My Lords and Gentlemen,—Be not startled if I address to all, and every of you, this century of summary heads of wonderful things, even after the dedication of them to his most excellent Majesty, since it is with his most gracious and particular consent, as well as indeed no way derogating from my duty to his sacred self, but rather in further order unto it, since your lordships, who are his great council, and you, gentlemen, his whole kingdom's representatives, (most worthily welcome unto him,) may fitly receive into your wise and serious considerations what doth or may publicly concern both his Majesty and his tenderly beloved people.

Pardon me if I say (my Lords and Gentlemen) that it is jointly your parts to digest to his hand these ensuing particulars, fitting them to his palate, and ordering how to reduce them into practice, in a way useful and beneficial both to his Majesty and his kingdom.

Neither do I esteem it less proper for me to present them to you, in order to his Majesty's service, than it is to give into the hands of a faithful and provident steward whatsoever dainties and provisions are intended for the master's diet; the knowing and faithful steward being best able to make use thereof to his master's contentment and greatest profit, keeping for the morrow whatever should be overplus or needless for the present day, or at least to save something else in lieu thereof. In a word (my Lords and Gentlemen), I humbly conceive this simile not improper, since you are his Majesty's provident stewards, into whose hands I commit myself with all properties fit to obey you, that is to say, with a heart harboring no ambition, but an endless aim to serve my King and country; and if my endeavors prove effectual (as I am confident they will), his Majesty shall not only become rich, but his

people likewise as treasures unto him; and his peerless Majesty, our King, shall become both beloved at home and feared abroad, deeming the riches of a king to consist in the plenty enjoyed by his people.

And the way to render him to be feared abroad is, to content his people at home, who then, with heart and hand, are ready to assist him; and whatsoever God blesseth me with to contribute towards the increase of his revenues in any considerable way, I desire it may be employed to the use of his people; that is, for the taking off such taxes or burthens from them as they chiefly groan under, and by a temporary necessity only imposed upon them, which being thus supplied will certainly best content the King and satisfy his people, which I dare say is the continual end of all your indefatigable pains, and the perfect demonstration of our zeal to his majesty, and an evidence that the kingdom's trust is justly and deservedly reposed in you. And if ever Parliament acquitted themselves thereof, it is this of yours, composed of most deserving and qualified persons—qualified, I say, with affection to your Prince, and with a tenderness to his people; with a bountiful heart towards him, yet a frugality in their behalf.

Go on, therefore, cheerfully (my Lords and Gentlemen), and not only our gracious King, but the King of Kings, will reward you; the prayers of the people will attend you; and his Majesty will, with thankful arms, embrace you. And be pleased to make use of me and my endeavors to enrich them, not myself. Such being my only request unto you, spare me not in what your wisdoms shall find me useful, who do esteem myself, not only by the act of the water-commanding engine (which so cheerfully you have past), sufficiently rewarded, but likewise with courage enabled me to do ten times more for the future; and my debts being paid, and a competency to live according to my birth and quality settled, the rest shall I dedicate to the service of our King and country, by your disposals; and esteem me not the more, or rather any more, by what is past, but what is to come; professing really, from my heart, that my intentions are to outgo the six or seven hundred thousand pounds already sacrificed, if countenanced and encouraged by you, ingenuously confessing that the melancholy which hath lately seized me, (the cause whereof none of you but may easily guess,) hath, I dare say, retarded more advantages to the public service than modesty will permit me to utter; and now, revived by your promising favors, I shall infallibly be able thereunto in the experiments extant and comprised under these heads, practicable with my directions by the unparalleled workman, both for trust and skill, Caspar Kaltoff's hand, who has been these five-and-thirty years as in a school, under me employed, and still at my disposal, in a place by my great expenses made fit for public service, yet lately like to be taken from me, and consequently from the service of King and kingdom, without the least regard of about ten thousand pounds expended by me, and through my zeal, to the common good; my zeal, I say, in a field large enough for you (my Lords and Gentlemen) to work upon.

The treasures buried under these heads, both for war, peace, and pleasure, being inexhaustible, I beseech you pardon me if I say so. It seems a vanity, but it comprehends a truth, since no good spring but becomes the more plentiful by how much more it is drawn, and the spinner to weave his web is never stinted but further enforced.

The more then that you shall be pleased to make use of my inventions, the more inventive shall you ever find me; one invention begetting still another, and more and more improving my ability to serve my King and you; and as to my heartiness therein, there needs no addition, nor to my readiness a spur. And therefore, my Lords and Gentlemen, be pleased to begin, and desist not from commanding me till I flag in my obedience and endeavors to serve my King and country:

> For certainly you'll find me breathless first t' expire,
> Before my hands grow weary, or my legs do tire.

Yet, abstracting from any interest of my own, but as a fellow-subject and compatriot, will I ever labor in the vineyard, most heartily and readily obeying the least summons from you, by putting faithfully in execution what your judgments shall think fit to pitch upon amongst this century of experiments, perhaps dearly purchased by me, but now frankly and *gratis* offered to you. Since my heart (methinks) cannot be satisfied in serving my King and country, if it should cost them any thing, as I confess, when I had the honor to be so near so obliging a master as his late Majesty, of happy memory, who never refused me his ear to any reasonable motion; and as for unreasonable ones, or such as were not fitting for him to grant, I would rather have to dyed a thousand deaths than ever to have made one unto him.

Yet whatever I was so happy as to obtain for any deserving person, my pains, breath, and interest, employed therein, satisfied me

not, unless I likewise satisfied the fees; but that was in my golden age. And even now, though my ability and means are shortened (the world knows why), my heart remains still the same; and be you pleased, my Lords and Gentlemen, to rest most assured, that the very complacency that I shall take in the executing your commands shall be unto me a sufficient and abundant satisfactory reward.

Vouchsafe, therefore, to dispose freely of me, and whatever lieth in my power to perform—first, in order to his Majesty's service; secondly, for the good and advantage of the kingdom; thirdly, to all your satisfactions, for particular profit and pleasure to your individual selves; professing that, in all and each of the three respects, I will ever demean myself as it best becomes,

My Lords and Gentlemen,

Your most passionately bent fellow-subject in His Majesty's service, compatriot for the public good and advantage, and a most humble servant to all and every of you,

WORCESTER.

A Century of the Names and Scantlings of Inventions by me already practised.

1. Several sorts of seals, some showing by screws, others by gages fastening or unfastening all the marks at once, others by additional points and imaginary places, proportionable to ordinary escocheons and seals to arms, each way palpably and punctually setting down (yet private from all others but the owner and by his assent) the day of the month, the day of the week, the month of the year, the year of our Lord, the names of the witnesses, and the individual place where any thing was sealed, though in ten thousand several places, together with the very number of lines contained in a contract, whereby falsification may be discovered and manifestly proved, being upon good grounds suspected.

Upon any of these seals a man may keep accounts of receipts and disbursements, from one farthing to an hundred millions, punctually showing each pound, shilling, penny, or farthing.

By these seals, likewise, any letter, though written but in English, may be read and understood in eight several languages, and in English itself to clean contrary and different sense, unknown to any but the correspondent, and not to be read or understood by him neither, if open before it arrives unto him; so that neither threats nor hopes of reward did make him reveal the secret, the letter having been intercepted and first opened by the enemy.

2. How ten thousand persons may use those seals to all and every of the purposes aforesaid, and keep their secrets from any but whom they please.

3. A cypher and character so contrived that one line, without returns and circumflexes, stands for each and every of the 24 letters, and as ready to be made for the one letter as the other.

4. This invention refined, and so abbreviated, that a point only showeth distinctly and significantly any of the 24 letters, and these very points to be made with two pens; so that no time will be lost, but as one finger riseth the other may make the following letter, never clogging the memory with several figures for words and combinations of letters, which with ease, and void of confusion, are thus speedily and punctually, letter for letter, set down by naked and not multiplied points. And nothing can be less than a point, the mathematical definition of it being *cujus pars nulla*. And of a motion no swifter imaginable than semiquavers or releshes, yet applicable to this manner of writing.

5. A way, by circular motion, either along a rule or ringwise, to vary an alphabet, even this of points, so that the self-same point, individually placed, without the least additional mark, or variation of place, shall stand for all the 24 letters, and not for the same letter twice in ten sheets writing, yet as easily and certainly read and known as if it stood but for one and the self-same letter constantly signified.

6. How, at a window, as far as eye can discover black from white, a man may hold discourse with his correspondent without noise made or notice taken; being, according to the occasion given and means afforded, *ex re nata*, and no need of provision beforehand, though much better if foreseen, and means prepared for it, and a premeditated course taken by mutual consent of parties.

7. A way to do it by night as well as by day, though as dark as pitch is black.

8. A way how to level and shoot cannon by night as well as by day, and as directly without a platform or measures taken by day, yet by a plain and infallible rule.

9. An engine portable in one's pocket, which may be carried and fastened on the inside of the greatest ship, *tanquam aliud agens*, and at any appointed minute, though a week after, either of day or night, it shall irrecoverably sink that ship.

10. A way, from a mile off, to dive and

fasten a like engine to any ship, so as it may punctually work the same effect either for time or execution.

11. How to prevent and safeguard any ship from such an attempt by day or night.

12. A way to make a ship not possible to be sunk, though shot an hundred times betwixt wind and water by cannon, and should lose a whole plank, yet in half an hour's time, should be made as fit to sail as before.

13. How to make such false decks, as in a moment should kill and take prisoners as many as should board the ship, without blowing the decks up or destroying them, from being reducible, and in a quarter of an hour's time should recover their former shape, and to be made fit for any employment, without discovering the secret.

14. How to bring a force to weigh up an anchor, or to do any forcible exploit, in the narrowest or lowest room in any ship, where few hands shall do the work of many; and many hands applicable to the same force, some standing, others sitting, and by virtue of their several helps, a great force augmented in little room, as effectual as if there were sufficient space to go about with an axle-tree, and work far from the centre.

15. A way to make a boat work itself against wind and tide, yea, both without the help of man or beast; yet so that the wind or tide, though directly opposite, shall force the ship or boat against itself, and in no point of the compass, but it shall be as effectual as if the wind were in the *pupp*, or the stream actually with the course it is to steer, according to which the oars shall row, and necessary motions work and move towards the desired port or point of the compass.

16. How to make a sea-castle or fortification cannon proof, and capable of containing a thousand men, yet sailable at pleasure to defend a passage; or, in an hour's time, to divide itself into three ships, as fit and trimmed to sail as before; and even whilst it is a fort or castle, they shall be unanimously steered, and effectually be driven, by an indifferent strong wind.

17. How to make upon the Thames a floating garden of pleasure, with trees, flowers, banqueting houses, and fountains, stews for all kinds of fishes, a reserve for snow to keep wine in, delicate bathing places, and the like; with music made* with mills, and all in the midst of the stream where it is most rapid.

* "By," MS. copy.

18. An artificial fountain, to be turned, like an hour-glass, by a child, in the twinkling of an eye; it holding a greater quantity of water, and of force sufficient to make snow, ice, and thunder, with a chirping and singing of birds, and showing off several shapes and effects usual to fountains of pleasure.

19. A little engine within a coach, whereby a child may stop it, and secure all persons within it, and the coachman himself, though the horses be never so unruly in a full career; a child being sufficiently capable to loosen them in what posture soever they should have put themselves, turning never so short, for a child can do it in the twinkling of an eye.

20. How to bring up water balancewise, so that as little weight or force as will turn a balance will be only needful, more than the weight of the water within the buckets, which counterpoised, empty* themselves one into the other, the uppermost yielding its water, how great a quantity soever it holds, at the self-same time the lowermost taketh it in, though it be an hundred fathom high.

21. How to raise water constantly with two buckets only, day and night, without any other force than its own motion, using not so much as any force, wheel or sucker, nor more pulleys than one on which the cord or chain rolleth, with a bucket fastened at each end. This I confess I have seen and learned of the great mathematician Claudius† his Studies at Rome, he having made a present thereof unto a Cardinal; and I desire not to own any other men's inventions, but if I set down any, to nominate likewise the inventor.

22. To make a river in a garden to ebb and flow constantly, though twenty foot over, with a child's force, in some private room, or place out of sight, and a competent dis tance from it.

23. To set a clock in‡ a castle, the water filling the trenches about it; it shall show by ebbing and flowing, the hours, minutes, and seconds, and all the comprehensible motions of the heavens, and counterlibration of the earth, according to Copernicus.

24. How to increase the strength of a spring to such a height as to shoot bumbasses and bullets of an hundred pound weight a steeple height, and a quarter of a mile off and more, stone-bowwise; admirable for fire-works, and astonishing of besieged cities, when, without warning given by

* "Counterpoised and empty."
† "Clavius."
‡ "As within."

noise, they find themselves so forcibly and dangerously surprised.

25. How to make a weight that cannot take up an hundred pound, and yet shall take up two hundred pound, and at the self-same distance from the centre; and so, proportionably, to millions of pounds.

26. To raise weight as well and as forcibly with the drawing back of the lever, as with the thrusting it forwards; and by that means to lose no time in motion or strength. This I saw in the arsenal at Venice.

27. A way to move to and fro huge weights, with a most inconsiderable strength, from place to place. For example, ten ton with ten pounds, and less; the said ten pounds not to fall lower than it makes the ten ton to advance or retreat upon a level.

28. A bridge, portable in* a cart with six horses, which in a few hours' time may be placed over a river half a mile broad, whereon, with much expedition, may be transported horse, foot, and cannon.

29. A portable fortification, able to contain five hundred fighting men; and yet, in six hours' time, may be set up, and made cannon proof, upon the side of a river or pass, with cannon mounted upon it, and as complete as a regular fortification, with half-moons and counterscarps.

30. A way in one night's time to raise a bulwark twenty or thirty feet high, cannon-proof, and cannon mounted upon it, with men to overlook, command, and batter a town; for though it contain but four pieces, they shall be able to discharge two hundred bullets each hour.

31. A way how, safely and speedily, to make an approach to a castle or town wall, and over the very ditch, at noon-day.

32. How to compose an universal character, methodical and easy to be written, yet intelligible in any language; so that if an Englishman write it in English, a Frenchman, Italian, Spaniard, Irish, Welsh, being scholars, yea, Grecian or Hebrean, shall as perfectly understand it in their own tongue as if they were perfect English, distinguishing the verbs from nouns, the numbers, tenses, and cases, as properly expressed in their own language as it was written in English.

33. To write with a needle and thread, white or any color, upon white or any other color, so that one stitch shall significantly show any letter, and as readily and as easily show the one letter as the other, and fit for any language.

34. To write by a knotted silk string, so that every knot shall signify any letter, with comma, full point, or interrogation, and as legible as with pen and ink upon white paper.

35. The like, by the fringe of gloves.

36. By stringing of bracelets.

37. By pink'd gloves.

38. By holes in the bottom of a sieve.

39. By a lattin, or plate lanthorn.*

40. By the smell.

41. By the taste.

42. By the touch.

Note.—By these three senses, as perfectly, distinctly, and unconfusedly, yea, as readily as by the sight.

43. How to vary each of these, so that ten thousand may know them, and yet keep the understanding part from any but their correspondent.

44. To make a key of a chamber door, which to your sight hath its wards and rose-pipe but paper thick, and yet at pleasure, in a minute of an hour, shall become a perfect pistol, capable to shoot through a breast-plate commonly of carabine proof, with prime, powder, and firelock, and is coverable in a stranger's hand.

45. How to light a fire and candle at what hour of the night one waketh, without rising or putting one's hand out of bed. And the same thing becomes† a serviceable pistol at pleasure; yet by a stranger, not knowing the secret, seemeth but a dexterous tinder-box.

46. How to make an artificial bird, to fly which way and as long as one pleaseth, by or against the wind, sometimes chirping, other times hovering, still tending the way it is designed for.

47. To make a ball of any metal, which, thrown into a pool or pail of water, shall presently rise from the bottom, and constantly show, by the superficies of the water, the hour of the day or night, never rising more out of water than just to the minute it showeth of each quarter of the hour; and if by force kept under water, yet the time is not lost, but recovered as soon as it is permitted to rise to the superficies of the water.

48. A screwed ascent, instead of stairs, with fit landing places to the best chambers of each story, with back stairs within the noell of it, convenient for servants to pass up

* "Upon."

* "Candlestick lantern."

† "To be."

and down to the inward rooms of them, unseen and private.

49. A portable engine, in the way of a tobacco-tongs, whereby a man may get over a wall, or get up again, being come down, finding the coast proving unsecure to him.

50. A complete light portable ladder, which, taken out of one's pocket, may be by himself fastened an hundred feet high, to get up by from the ground.

51. A rule of gradation, which with ease and method reduceth all things to a private correspondence, most useful for secret intelligence.

52. How to signify words, and a perfect discourse, by jangling of bells of any parish church, or by any musical instrument within hearing, in a seeming way of tuning it, or of an unskilful beginner.

53. A way how to make hollow and cover a water-screw, as big and as long as one pleaseth, in an easy and cheap way.

54. How to make a water-screw tight, and yet transparent and free from breaking, but so clear that one may palpably see the water, or any heavy thing, how and why it is mounted by turning.

55. A double water-screw, the innermost to mount the water, and the outermost for it to descend more in number of threads, and consequently, in quantity of water, though much shorter than the innermost screw, by which the water ascendeth—a most extraordinary help for the turning of the screw to make the water rise.

56. To provide and make, that all the weights of the descending side of the wheel shall be perpetually further from the centre than those of the mounting side, and yet equal in number and heft to* the one side as the other. A most incredible thing, if not seen, but tried before the late King (of blessed memory)† in the Tower, by my directions, two extraordinary Embassadors accompanying his Majesty, and the Duke of Richmond and Duke Hamilton, with most of the Court attending him. The wheel was 14 foot over, and 40 weights, of 50 pounds apiece. Sir William Balfore,‡ then Lieutenant of the Tower, can justify it, with several others. They all saw, that no sooner the great weights passed the diameter line of the lower§ side, but they hung a foot further from the centre; nor no sooner passed the diameter line of the upper* side, but they hung a foot nearer. Be pleased to judge the consequence.

57. An ebbing and flowing water-work, in two vessels, into either of which, the water standing at a level, if a globe be cast in, instead of rising it presently ebbeth, and so remaineth until a like globe be cast into the other vessel, which the water is no sooner sensible of, but that† vessel presently ebbeth, and the other floweth, and so continueth ebbing and flowing until one or both of the globes be taken out, working some little effect besides its own motion, without the help of any man within sight or hearing; but if either of the globes be taken out, with ever so swift or easy a motion, at the very instant the ebbing and flowing ceaseth; for if during the ebbing you take out the globe, the water of that vessel presently returneth to flow, and never ebbeth after, until the globe be returned into it, and then the motion beginneth as before.

58. How to make a pistol discharge a dozen times with one loading, and without so much as once new priming requisite, or to change it out of one hand into the other, or stop one's horse.

59. Another way, as fast and effectual, but more proper for carabines.

60. A way, with a flask appropriated unto it, which will furnish either pistol or carabine with a dozen charges in three minutes' time, to do the whole execution of a dozen shots, as soon as one pleaseth, proportionably.

61. A third way, and particular for muskets, without taking them from their rests to charge or prime, to a like execution, and as fast as the flask, the musket containing but one charge at a time.

62. A way for a harquebuss, a crock, or ship musket, six upon a carriage, shooting with such expedition, as, without danger, one may charge, level, and discharge them sixty times in a minute of an hour, two or three together.

63. A sixth way, most excellent for sakers, differing from the other, yet as swift.

64. A seventh, tried and approved before the late King (of ever blessed memory), and a hundred Lords and Commons, in a cannon of eight inches half quarter, to shoot bullets of 64 lbs. weight, and 24 lbs. of powder, twenty times in six minutes; so clear from danger that after all were discharged, a

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* "Of."
† "Of happy and glorious," &c.
‡ "Sir W. Belford."
§ "Uppor.

* "Lower."
† "The."

pound of butter did not melt, being laid upon the cannon britch, nor the green oil discolored that was first annointed and used between the barrel thereof, and the engine having never in it, nor within six foot of it, but one charge at a time.

65. A way that one man, in the cabin, may govern the whole side of ship musquets, to the number (if need require) of two or three thousand shots.

66. A way that, against several avenues to a fort or castle, one man may charge fifty cannons playing, and stopping when he pleaseth, though out of sight of the cannon.

67. A rare way, likewise, for musquetoons fastened to the pummel of the saddle, so that a common trooper cannot miss to charge them with twenty or thirty bullets at a time, even in full career.

"When I first gave my thoughts to make guns shoot often, I thought there had been but one only exquisite way inventible, yet by several trials and much charge, I have perfectly tried all these."

68. An admirable and most forcible way to drive up water by fire, not by drawing or sucking it upwards, for that must be, as the philosophers calleth it, *infra sphæram activitatis*, which is but at such a distance. But this way hath no bounder, if the vessels be strong enough; for I have taken a piece of a whole cannon, whereof the end was burst, and filled it three quarters full of water,* stopping and screwing up the broken end, as also the touch-hole, and making a constant fire under it, within 24 hours it burst and made a great crack; so that having a way† to make my vessels so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant fountain-stream, 40 foot high; one vessel of water, rarified by fire, driving up 40 of cold water. And a man that tends the work is but to turn two cocks, that one vessel of water being consumed, another to force and re-fill with cold water, and so successively, the fire being tended and kept constant, which the self-same person may likewise abundantly perform in the interim between the necessity of turning the said cocks.

69. A way how a little triangle screwed key, not weighing a shilling, shall be capable‡ and strong enough to bolt and unbolt, round about a great chest, an hundred bolts, through fifty staples, two in each, with a direct contrary motion, and as many more from both sides and ends; and, at the self-same time, shall fasten it to the place, beyond a man's natural strength to take it away; and in one and the same turn, both locketh and openeth it.

70. A key, with a rose-turning pipe, and two roses pierced through endwise the bit thereof,* with several handsomely contrived wards, which may likewise do the same effects.

71. A key perfectly square, with a screw turning within it, and more conceited than any of the rest, and no heavier than the triangle-screwed key, and doth the same effects.

72. An escutcheon to be placed before any of these locks, with these properties:

1st. The owner (though a woman) may, with her delicate hand, vary the ways of coming to open the lock ten millions of times, beyond the knowledge of the smith that made it, or of me who invented it.

2d. If a stranger openeth it, it setteth an alarm a-going, which the stranger cannot stop from running out; and, besides, though none should be within hearing, yet it catcheth his hand, as a trap doth a fox; and though far from maiming him, yet it leaveth such a mark behind it as will discover him, if suspected; the escutcheon, or lock, plainly showing what moneys he hath taken out of the box to a farthing, and how many times opened since the owner had been at it.

73. A transmittable gallery over any ditch or breach in a town wall, with a blind and parapit cannon proof.

74. A door, whereof the turning of the key, with the help and motion of the handle, makes the hinges to be of either side, and to open either inward or outward, as one is to enter or to go out, or to open in half.

75. How a tape or ribbon-weaver may set down a whole discourse, without knowing a letter or interweaving any thing suspicious of other secret than a new-fashioned ribbon.

76. How to write in the dark as straight as by day or candle-light.

77. How to make a man fly, which I have tried with a little boy of ten years old in a barn, from one end to the other, on a haymow.

78. A watch to go constantly, and yet needs no other winding from the first setting on the cord or chain, unless it be broken; requiring no other care from one man than

* "Full"—merely.

† "Found a way."

‡ "Triangle *and* screwed key shall be capable."

* "Together."

to be now and then consulted with concerning the hour of the day or night; and if it be laid by a week together, it will not err much, but the oftener looked upon the more exact it showeth the time of the day or night.

79. A way to lock all the boxes of a cabinet (though never so many) at one time, which were by particular keys, appropriated to each lock, opened severally and independent the one of the other, as much as concerneth the opening of them, and by these means cannot be left open unawares.

80. How to make a pistol barrel no thicker than a shilling, and yet able to endure a musquet proof of powder and bullet.

81. A combe-conveyance carrying of letters, without suspicion, the head being opened by a needle-screw drawing a spring towards them,* the combe being made but after an usual form carried in one's pocket.

82. A knife, spoon, or fork, in an usual portable case, may have the like conveyances in their handles.

83. A raspin-mill, for hartshorn, whereby a child may do the work of half-a-dozen men, commonly taken up with that work.

84. An instrument, whereby persons ignorant of arithmetic may perfectly observe numerations and substractions of all sums and fractions.

85. A little ball made in the shape of a plum or pear, being† dexterously conveyed or forced into a body's mouth, shall presently shoot forth such and so many bolts of each side and at both ends, as, without the owner's key, can neither be opened or filed off, being made of tempered steel, and as effectually locked as an iron chest.

86. A chair, made *a-la-mode*, and yet a stranger being persuaded to set down in't, shall have his arms and thighs locked up beyond his own power to loosen them.

87. A brass mould to cast candles, in which a man may make 500 dozen in a day, and add an ingredient to the tallow which will make it cheaper, and yet so that the candles shall look whiter and last longer.

88. ‡How to make a brazen or stone head, in the midst of a great field or garden, so artificial and natural, that though a man speak never so softly, and even whispers into the ear thereof it will presently open its mouth, and resolve the question in French, Latin, Welsh, Irish, or English, in good terms uttering out of his mouth, and then shut it until the next question be asked.

89. White silk, knotted in the fingers of a pair of white gloves, and so contrived, without suspicion, that playing at primero, at cards, one may, without clogging his memory, keep reckoning of all sixes, sevens, and aces, which he hath discarded.*

90. A most dexterous dicing box, with holes transparent, after the usual fashion, with a device so dexterous, that, with a knock of it against the table, the four good dice are fastened, and it looseneth four false dice made fit for the purpose.

91. An artificial horse, with saddle and caparisons fit for running at the ring, on which a man being mounted, with his lance in his hand, he can at pleasure make him start, and swiftly run his career, using the decent posture with *bon grace*, may take the ring as handsomely, and running as swiftly, as if he rode upon a barbe.

92. A screw, made like a water-screw, but the bottom made of iron plate, spadewise, which, at the side of a boat, emptieth the mud of a pond or raiseth gravel.

93. An engine, whereby one man may take out of the water a ship of 500 ton, so that it may be calked, trimmed, and repaired, without need of the usual way of stocks, and as easily let it down again.

94. A little engine, portable in one's pocket, which placed to any door, without any noise but one crack, openeth any door or gate.

95. A double cross-bow, neat, handsome, and strong, to shoot two arrows, either together, or one after the other, so immediately, that a deer cannot run two steps, but, if he miss of one arrow, he may be reached with the other, whether the deer run forward, sideward, or start backward.

96. A way to make a sea-bank so firm and geometrically strong, so that a stream can have no power over it; excellent, likewise, to save the pillar of a bridge, being cheaper and stronger than stone walls.

97. An instrument whereby an ignorant person may take any thing in perspective as justly, and more, than the skilfullest painter can do by his eye.

98. An engine, so contrived, that working the *primum mobile* forward or backward, upward or downward, circularly or cornerwise, to and fro, straight, upright, or downright, yet the pretended operation continueth, and advanceth none of the motions abovementioned, hindering, much less stop-

* "One"

† "Which being"

‡ "An engin without ye least noyse, knock, or use of fyre, to coyne and stamp 100 lb. in an houre by one man."

* "Without foul play."

ping, the other; but unanimously and with harmony agreeing, they all augment and contribute strength unto the intended work and operation; and, therefore, I call this *a semi-omnipotent engine,* and do intend that a model thereof be buried with me.

99. How to make one pound weight to raise an hundred as high as one pound falleth, and yet the hundred pound descending doth what nothing less than one hundred pound can effect.

100. Upon so potent a help as these two last-mentioned inventions, a water-work is, by many years' experience and labor, so advantageously by me contrived, that a child's force bringeth up, an hundred foot high, an incredible quantity of water, even two feet diameter, *so naturally, that the work will not be heard, even in to the next room; and with so great ease and geometrical symmetry, that though it work day and night, from one end of the year to the other, it will not require forty shillings reparation to the whole engine, nor hinder one's day-work,** and I may boldly call it the most stupendous work in the whole world; not only, with little charge, to drain all sorts of mines, and furnish cities with water, though never so high seated, as well to keep them sweet, running through several streets, and so performing the work of scavengers, as well as furnishing the inhabitants with sufficient water for their private occasions; but likewise supplying rivers with sufficient to maintain and make them portable from town to town, and for the bettering of lands all the way it runs; with many more advantageous and yet greater effects of profit admirable and consequence. So that deservedly I deem this invention to crown my labors, to reward my expenses, and make my thoughts acquiesce in way of further inventions; this making up the whole century, and preventing any further trouble to the reader for the present, meaning to leave to posterity a book, wherein, under each of these heads, the means to put in execution, and visible trial, all and every of these inventions, with the shape and form of all things belonging to them, shall be printed by brass plates.

In bonum publicum, et ad majorem Dei gloriam.†

* The words marked in italics not in the MS.

† "Besydes many omitted, and some of three sorts willingly not set downe, as not fitt to be divulged, least ill use may bee made thereof; butt to show that such things are also within my knowledge, I will here in myne own cypher set downe one of each, not to be concealed when duty and affection obligeth me."

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* "Index."

† "A *mute* yet perfect discourse, as far distant as eye can reach by day to discern colors."

‡ "Though never soe darke."

§ "Multiplying."

‖ "Flowing clock."

¶ *For weights*—wanting in the MS.

** *And each of these*—wanting.

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63—For sakers* and minyons.
64—For the biggest cannon.†
65—For a whole side of ‡ ship musquets.
66—For guarding several avenues to a town.
67—For musquetoons on horseback.
68—A fire water-work.
69—A triangle key.
70—A rose key.
71—A square key, with a turning screw.
72—An escutcheon for all locks.
73—A transmittable gallery.
74—A conceited door.
75—A discourse woven in tape or ribbon.§
76—To write in the dark.
77—A flying man.
78—A continually going watch.‖
79—A total¶ locking of cabinet boxes.
80—Light pistol barrels.
81—A combe-conveyance for letters.**
82—A knife, spoon, or fork conveyance.
83—A rasping mill.
84—An arithmetical instrument.
85—An untoothsome pear.
86—An imprisoning chair.
87—A candle mould.
88—A brazen head, or speaking figure.††
89—Primero gloves.‡‡
90—A dicing-box.§§
91—An artificial ring-horse.
92—A gravel engine.
93—A ship-raising engine.
94—A pocket engine to open any door.
95—A double cross-bow.
96—A way for sea banks.
97—A perspective instrument.
98—A semi-omnipotent engine.
99—A most admirable way to raise weights.*
100—A stupendous water-work.

* Forsacres.

† "For whole cannon."

‡ *A whole side of*—wanting.

§ *Or ribbon*—wanting.

‖ "A continual watch."

¶ *A total*—wanting.

** "81, 82. Conveyance for letters."

†† Wanting entirely in the MS.

‡‡ "Stamping engine."

§§ "Primero gloves." The Marquis seems to have been in doubt which he should erase—the brazen head or the dicing-box.

* Wanting in the MS

On the Equal Action and Reaction of Motions and Forces. By Dr. Arnott.

"There is no motion or action in the universe, without a concomitant and opposite action of equal amount."

This truth has otherwise been expressed —"action and reaction are equal and contrary." It is clear that if no action or movement takes place on earth but in consequence of either attraction or repulsion—and this has now been shown—there must always be two objects or masses concerned, and each must be *attracted* or *repelled* just as much as the other, although one will have less velocity than the other, as it may be itself greater, or fixed to another mass.

If a man in one boat pull at a rope attached to another, the two boats will approach. If they be of equal size and load, they will both move at the same rate, in whichever of the boats the man may be; and if there be a difference in the sizes, and resistances, there will be a corresponding difference in the velocities, the smaller boat moving the fastest.

A magnet and a piece of iron attract each other equally, whatever disproportion there is between the masses. If either be balanced in a scale, and the other be then brought within a certain distance beneath it, the very same counterpoise will be required to prevent their approach, whichever be in the scale. If the two were hanging near each other as pendulums, they would approach and meet; but the little one would perform more than half of the journey.

A man in a boat pulling a rope attached to a large ship, seems only to move the boat: but he really moves the ship a little, for, supposing the resistance of the ship to be just a thousand times greater than that of the boat, a thousand men in a thousand boats, pulling simultaneously in the same manner, would make the ship meet them half way.

A pound of lead and the earth attract each other with equal force, but that force makes the lead approach sixteen feet in a second

towards the earth, while the contrary motion of the earth is of course as much less than this as the earth is weightier than one pound—and is therefore unnoticed. Speaking strictly, it is true, that even a feather falling lifts the earth towards it, and that a man jumping kicks the earth away.

A spring unbending between two equal bodies, throws them off with equal velocity; if between bodies of different magnitudes the velocity is greater in the smaller body, and in proportion to the smallness.

On firing a cannon, the gun recoils with even more motion or momentum in it than the ball has, for it suffers the reaction of the expelled gun-powder as well as of the ball; but the momentum in the gun being diffused through a greater mass, the velocity is small, and easily checked.

In the art of projectiles, it has lately been proposed, as promising a great saving of weight in the field or on ship board, besides other advantages, that instead of shooting round bullets from a great barrel or cannon, as at present, the bullets should be made somewhat of barrel-shape, or should have a small barrel as a tail, and should be shot away from a strong fixed spindle or closefitting ramrod, which would then constitute the piece of ordnance. Such a projectile, for the reason stated in the last paragraph, receives more momentum from a given quantity of gunpowder than a common ball does. The experiment has been tried by the ingenious proposer, Mr. Levier, with satisfactory result.

The recoil of a light fowling-piece will hurt the shoulder, if the piece be not held close to it.

A ship in chase, by firing her bow guns, retards her motion; by firing from her stern she quickens it.

A ship firing a broadside heels or inclines to the opposite side.

A vessel of water suspended by a cord hangs perpendicularly; but if a hole be opened in one side, so as to allow the water to jet out there, the vessel will be pushed to the other side by the reaction of the jet, and will so remain while it flows. If the hole be oblique, the vessel will turn round constantly.

A vessel of water placed upon a floating piece of plank, and allowed to throw out a jet, as in the last case, moves the plank in the opposite direction.

A steamboat may be driven by making the engine pump or squirt water from the stern, instead of making it, as usual, move paddle-wheels. There is a loss of power however in this mode of applying it, as will be explained under the head of "Hydraulics."

A man floating in a small boat, and blowing strongly with a bellows towards the stern, pushes himself onwards with the same force with which the air issues from the bellows pipe.

A sky-rocket ascends, because, after it is lighted, the lower part is always producing a large quantity of aeriform fluid, which, in expanding, presses not only on the air below, but also on the rocket above, and thus lifts it. The ascent is aided also by the recoil of the rocket from the part of its substance, which is constantly bursting downwards.

He was a foolish man who thought he had found the means of commanding always a fair wind for his pleasure-boat, by erecting an immense bellows in the stern. The bellows and sails acted against each other, and there was no motion: indeed, in a perfect calm, there would be a little backward motion, because the sail would not catch all the wind from the bellows.

A man supported on a floating plank, by walking towards one end of it gives it a motion in the direction opposite.

A man using an oar, or a steam-engine turning paddle-wheels, advances exactly with the force that drives the water astern.

A swimmer pressing the water downwards and backwards with his hands, is sent forwards and upwards with the same force, by the reaction of the water.

And a bird flying is upheld with exactly the force with which it strikes the air in the opposite direction.

A man pushing against the ground with a stick may be considered as compressing a spring between the earth and the end of his stick, which spring is therefore pushing him up as much as he pushes down; and if, at the time, he were balanced in the scale of a weighing beam, he would find that he weighed just as much less as he was pressing with his stick.

Thus an invalid, on a spring plank or chair, who, by a trifling downward pressure of his hand on a staff or on a table, causes his body to rise and fall through a great range, and thus obtains the advantage of almost passive exercise, is really lifting himself while he presses downward.

When a child cries, on knocking his head against a table or pane of glass, it is common to tell him, and it is true, that he has given as hard a blow as he has received; al-

though his philosophy, probably, looking chiefly to results, blames the table for his head hurt, and his head for the glass broken.

The difference of momentum acquired in a fall of one foot or of several is well known : the corresponding intensities of reaction are unpleasantly experienced by a man who, in sitting down where he supposed a chair to be, unexpectedly reaches the floor.

What motion the wind has given to a ship it has itself lost, that is to say, the ship has reacted on the moving air: as is seen when one vessel is becalmed on the lee of another.

When one billiard ball strikes directly another ball of equal size it stops, and the second ball proceeds with the whole velocity which the first had—the action which imparts the new motion being equal to the reaction which destroys the old. Although the transference of motion, in such a case, seems to be instantaneous, the change is really progressive, and as follows. The approaching ball, at a certain point of time, has just given half of its motion to the other equal ball, and if both were of soft clay, they would then proceed together with half the original velocity; but, as they are elastic, the touching parts at the moment supposed are compressed like a spring between the balls, and by then expanding, and exerting force equally both ways, they double the velocity of the foremost ball, and destroy altogether the motion of that behind.

If a billiard ball be propelled against the nearest one of a row of balls equal to itself, it comes to rest as in the last case described, while the farthest ball of the row darts off with its velocity—the intermediate balls having each received and transmitted the motion in a twinkling, without appearing themselves to move.

As further illustrative of the truths, that action and reaction are equal and contrary, and that in every case of hard bodies striking each other, they may be regarded as compressing a very small strong spring between them, we may mention, that when any elastic body, as a billiard ball, strikes another body larger than itself, and rebounds, it gives to that other, not only all the motion which it originally possessed, this being done at the moment when it comes to rest, but an additional quantity, equal to that with which it recoils—owing to the equal action in both directions of the repulsion or spring which causes the recoil. When the difference of size between the bodies is very great, the returning velocity of the smaller is nearly as great as its advancing motion was, and thus it gives a momentum to the body struck, nearly double of what it originally itself possessed. This phenomenon constitutes the paradoxical case of an effect being greater than its cause, and has led persons, imperfectly acquainted with the subject, to seek from the principle a *perpetuum mobile.* A hammer on rebounding from an anvil has given a blow of nearly double the force which it had itself, for the anvil felt its full original force while stopping it, and then, equally with itself, was affected by the repulsion which caused its return.

Many more interesting facts might be adduced as examples of equal action and reaction, but these will suffice.

Canning's Life-Raft. By W. Baddeley.

[From the London Mechanics' Magazine.]

Sir,—It is probable that during the last summer many of your readers may have seen on the River Thames, in the vicinity of New London and Blackfriars Bridges, a singular-looking machine, composed of spars and floated by barrels, the object of which was not very apparent.

The machine is, however, one of considerable importance to the maritime world, being a life-raft, invented by Mr. Alfred Canning, R. N. for the relief of persons in danger of shipwreck; and as a knowledge of its construction cannot be too widely circulated, I beg to submit the following description for insertion in your Magazine.

There are two forms of Mr. Canning's raft, as represented by figs. 1 and 2.

In fig. 1, A is a main-yard or other spar, with two cross-spars, *b b*, lashed near each end of it, and kept in their places by the rope or stays *c c*. To give the necessary firmness to the machine, four of the ropes terminate in a loop at *d d*, through which a smaller cord is rove, and braced up *taut.*

The machine is floated by means of empty water-casks, one being attached to each end of the cross-spars *b b*. The projecting end of each cask is covered with a hammock, to protect them from being stove in by rocks, &c. &c. The number and disposition of the casks must, of course, be regulated by the number of persons to be carried. When the number is great, it is advisable to place the barrels as shown by the dotted lines, to obtain sufficient buoyancy. The raft exhibited on the river was so supported.

A platform *e*, for the reception of passengers, is slung upon the main-yard A by a

Fig. 1.

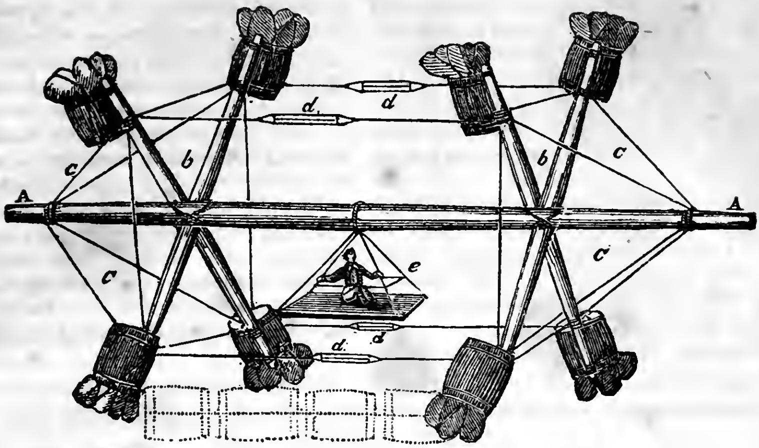
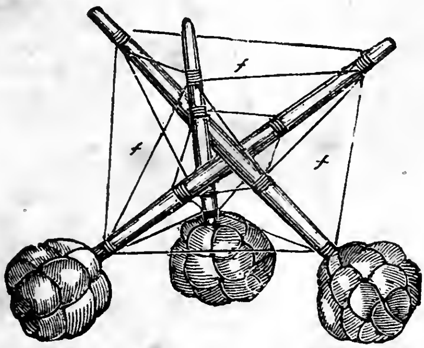


Fig. 2.



strong loop, so as to turn freely upon it; one or two loops being used, according to the size of platform required. The loops are kept in the middle of the yard by a chock on each side of them.

It will be observed that only four of the casks can be immersed at one time, and the object of the inventor in using twice that number is to permit the raft to roll over, without any risk to the parties on the platform *e*: that being suspended as just described, so as to retain a horizontal position, whichever set of barrels may be undermost.

Fig. 2 shows another modification of this raft. It is composed of three spars, lashed together crosswise at the middle, and braced up by means of the ropes *f f f*. To each end of these spars (for the sake of clearness, only one is shown in the drawing,) is attached an empty cask, or a cork-fender, to give a requisite buoyancy. If casks are used, they should be protected with hammocks, as before described. The persons upon this raft support themselves in the centre, holding on by the ropes, and shifting themselves whenever the raft rolls over.

It is right to state that the merits of this raft do not rest upon fresh-water experiments: Mr. Canning having made numerous trials with it on various parts of the French and English coasts, with invariable success, particularly at Cherbourg and Jersey. At the former place, a raft of the description shown at fig. 1 was drawn out to the head of the jetty in very stormy weather: Mr. Canning having seated himself on the platform, the raft was turned adrift, and was driven by the wind across the mouth of the harbor upon the rocks, and was eventually thrown by the waves, high and dry, upon a shore of the most dangerous character, without any injury either to the machine or to Mr. Canning.

The machine possesses the requisite firmness and stability, with just so much elasti-

city as is necessary for its safety. It carries the persons on it higher, and consequently drier, than any other raft; and is perfectly safe and certain on shores where a life-boat would inevitably be dashed to pieces. The materials of which it is composed are such as may be found on board almost every ship, and the raft may be put together in a comparatively short period of time.

When a vessel has been wrecked on a lee-shore, and a communication formed by means of Captain Manby's apparatus, or the more recent improvements of Mr. Murray, this raft would be found a most eligible mode of landing the crew.

Mr. Canning, some time since, exhibited and explained the construction of his raft, in a lecture delivered to the members of the Mechanics' Institution, in which he gave an interesting account of several of his experiments in different places, and expressed his readiness to put to sea in the severest storm, on any part of the British coast: thereby showing his perfect confidence in the safety and efficiency of his simple life-raft.

The Society of Arts have presented Mr. Canning with their large silver medal, as a token of the high opinion they entertain of the ingenuity of his contrivance; and *I guess* it will be some time before they have an opportunity of rewarding another of equal merit.

METEOROLOGICAL RECORD, FOR THE WEEK ENDING MONDAY, FEBRUARY 25, 1833.

KEPT IN THE CITY OF NEW-YORK.

[Communicated for the American Mechanics' Magazine.]

Date.	*Hours.*	*Barometer.*	*Thermometer.*	*Winds.*	*Strength of Wind.*	*Clouds from what direction.*	*Weather and Remarks.*
Tuesday, Feb. 19..	6 a. m.	29.68	42	SSW	moderate	WSW	cloudy
	10	.73	44	..	..	..	.. —rain
	2 p. m.	.72	44	..	..	..	rainy—cloudy
	6	.70	43	..	..	..	cloudy
	10	.75	41	..	..	..	..
Wednesday, " 20.	6 a. m.	.84	40	SSW—SW	..	..	..
	10	.89	42	WSW	..	..	..
	2 p. m.	.80	48	..	..	..	..
	6	.84	46	..	..	..	..
	10	.95	35	..	..	..	..
Thursday, " 21..	6 a. m.	30.08	25	NNW	..	..	cloudy—fair
	10	.15	30	NW—WSW	..	WSW / WNW	fair—scud cloud from WNW
	2 p. m.	.11	34	WSW—WNW	fresh	W by S—WNW	..
	6	.14	32	WNW	moderate		..
	10	.19	30	..	..		clear
Friday, " 22..	6 a. m.	.20	30	SW by W	..	WSW	fair [from WSW
	10	.20	38	..	fresh	..	.. —thin cirrous cloud
	2 p. m.	.09	45	..	strong	..	.. —beautifully variega-
	6	.00	42	..	moderate	..	.. [ted *cirri*
	10	29.98	38	..	light		clear
Saturday, " 23..	6 a. m.	.95	35	SW	moderate		..
	10	30.05	44	SW to NW	..	WSW	fair
	2 p. m.	.05	46	NW to NE	..	..	..
	6	.10	42	NE	..	..	..
	10	.15	34	NNE	..		.. —bank of clouds at NNW
Sunday, " 24..	6 a. m.	29.94	35	NE by E	..	WSW / E	cloudy—wind scuds from E
	10	.83	38	..	..	WSW / SE	.. —clouds moving swiftly
	2 p. m.	.57	46	..	..	SW / ESE —SSW	fair—bar. low't at 5, bank of clouds rising from WSW
	6	.47	40	NNE—NW	gale		at 7.15 sudden gale from NW
	10	.66	22	NW	..		snow [with rain and snow
Monday, " 25..	6 a. m.	30.00	18	..	fresh strong	WSW / NW	fair—wind scuds from NW
	10	.02	24	..	strong	.. / ..	..
	2 p. m.	.07	27	..	..	NW	..
	6	.18	24	NNW	moderate		..
	10	.30	22	NW	..		clear

Average temperature of the week, 36.16.

MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME I.] MARCH, 1833. [NUMBER 3.

Until the present epoch the sciences have been the patrimony of a few: but they are already become common, and the moment approaches in which their elements, their principles, and their most simple practice, will become really popular. Then it will be seen how truly universal their utility will be in their application to the Arts, and their influence on the general rectitude of the mind.—CONDORCET.

MR. HOTCHKISS' PATENT GRIST MILL.

Fig. 1.

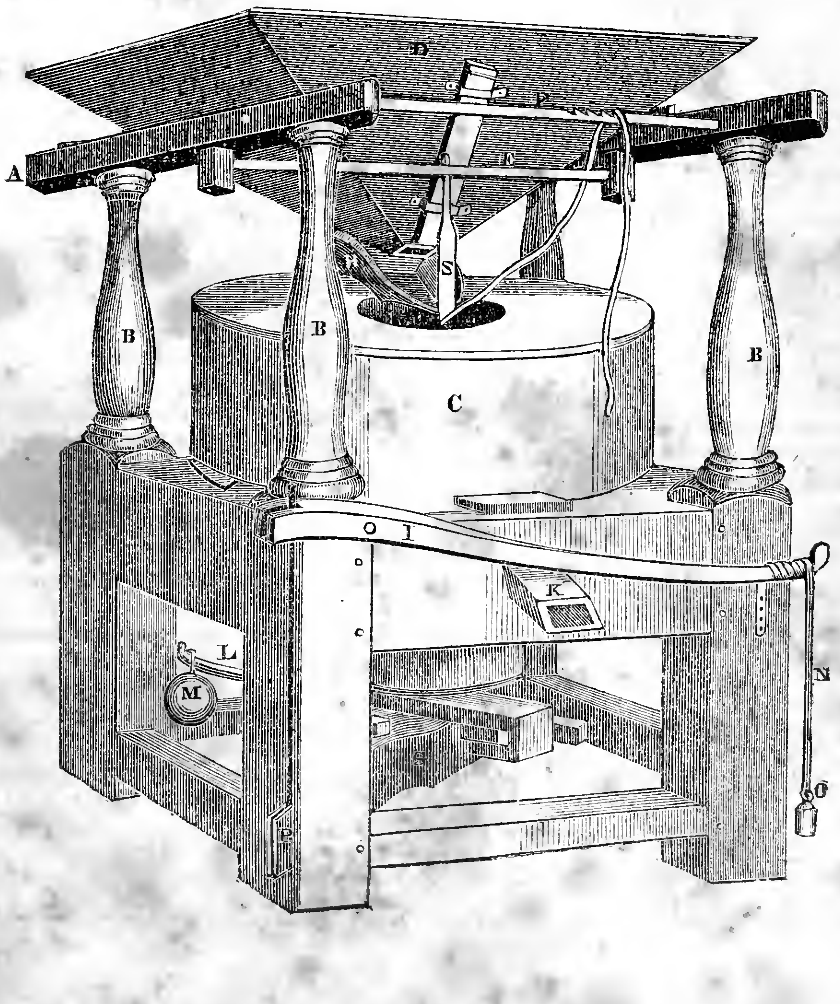


Fig. 2.

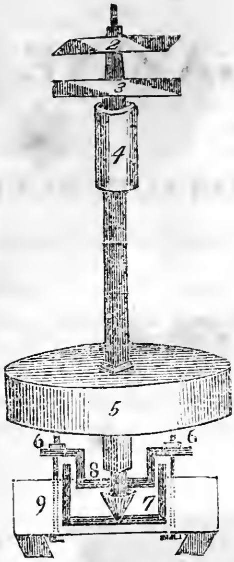
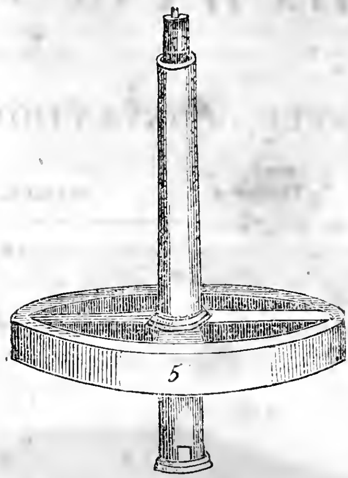


Fig. 3.

Fig. 4.



Mr. Hotchkiss' Patent Grist Mill. Communicated by the Inventor, for the Mechanics' Magazine and Register of Inventions and Improvements.

WINDSOR, Broome county, New-York, March 7, 1833.

SIR,—I herewith send you a drawing and description of my improved Grist Mill.

REFERENCES.—Fig. 1. A, the ladder, or top of the hopper frame; B, husk posts; C, hoop enclosing the stone; D, hopper; E, cross-bar, that receives the top of the damsel; F, do. over which the strap crosses that supports the shoe; G, the pressure lever, that gives weight or gravity to the runner; H, the shoe; I, lighter staff; K, meal spout; L, pressure lever; M, weight on the pressure lever; N, strap on the lighter staff; O, weight on said strap; P, rod, or sword piece, that connects the lighter staff and bridge-tree; S, the damsel.

Fig. 2. The top represents the screw part of the spindle; 2, balance rind and wings of flights; 3, driver, and do. do. (see also Fig. 3); 4, collar to spindle; 5, pully on lower end of spindle; 6, screws, or staples, to hold binding irons; 7, inside of oil-pot; 8, binding irons, two of which and foot of spindle form the lock joint; 9, tram block, which is fast to the bridge-tree.

Fig. 3. Driver, and balance rind and wings of flights (see also Fig. 2.)

Fig. 4. The propelling wheel.

The principal objects to be effected by my improvement are to perform fast grinding with small stones, without heating the flour; thereby lessening the expense in erecting the mill, and requiring less power to drive it.

Also to improve mills now in use, by placing the hereinafter described cylinder and flights in the eye of the runner, to keep the stones cool and to make the flour better.

The frame on which the stones, &c. are placed, is made by framing together four posts, one at each corner, and eight girts, four of which to be of sufficient width to receive and support the beams bearing the stones and the flooring around the bed stone. One of the lower girts is of sufficient size to receive an end of the bridge-tree inserted in a mortise in the same; the other end resting on the centre of the brake moving on a joint inside of the opposite girt.

On the middle of the bridge-tree rests a key or tram block, in which is secured the oil-pot or box. In the centre of the oil-box turns the foot or lower point of the spindle. The spindle is made of iron and steel, with a flange or circular projection near the lower end. An iron lock-joint made in two parts encircles the spindle immediately above the flange or projection, and is screwed to the tram block, which secures the foot or point of the spindle in the oil-box and prevents its escaping or bounding out there-

from. The spindle, as high as the collar, and square part on which is placed the driver, is made in the usual manner. The shoulders of the spindle above the driver are to be rounded off in a semi-globular form, on which rests the balance-rind and runner; the balance-rind, where it rests on the semi-globular shoulder, being of a semi-spherical concave shape, its upper side is convex; on which, and around the spindle, is put a circular washer or catteral concave on its under side, resting on the balance-rind. Above this is put a nut, screwed on the spindle, the threads of which being cut in a contrary direction from the turning of the stone, the catteral may be secured by a key passing through the spindle; or it may be otherwise fastened. The spindle is connected and suspended from the runner; the latter being nicely balanced on the spindle, having a motion similar to a ship's compass, and, whilst running, constantly forming itself to the bed-stone in the nicest manner. The damsel is screwed, or otherwise fastened, to the upper end of the spindle.

A pully whirl, drum or cog-wheel, is placed on the spindle to drive the same. A weight is added to the spindle in order to give greater power or gravity to the runner when required, which may, therefore, be of smaller size, and will move with greater velocity; thereby lessening the expense and power required in constructing and driving the mill.

The driver and balance-rind are curved or twisted in such a manner as to answer the purpose of flights or wings, which, during the operation of the mill, carry round and force the air which is in the eye of the runner between it and the bed-stone along deep channels cut in the runner—or pipes inserted to distribute the air—and out of the circumference thereof: also through grooves cut on the periphery of a hollow cylinder inserted in the eye of the runner, creating a current of air through these grooves, and a draft or suction through the eye, causing a more free, easy, and quick admission of the grain between the stones.

Mills that grind fast are liable to heat the flour, and consequently injure it,—but the currents of air, created as before described, and driven between the stones, prevent this from taking place.

To the brake may be attached a screw or lighter staff in the usual way, to raise or sink the runner at pleasure. Also, near one end of the brake, and on it are placed weights and springs, or a fulcrum supporting a lever, attached to one of the corner posts of the frame by a bolt passing through one of its ends, and having a weight suspended near the other end, in the manner of a steelyard, by which the gravity or power of the runner may be increased or diminished at pleasure, so that an equilibrium is formed between the power required and power applied.

The hoop, hopper-frame, hopper, and shoe, are made in the usual manner.

What I claim as my invention, and for which I obtained letters patent, is increasing the gravity of the runner by means of weight attached to the spindle, or by means of the flange near the bottom of the spindle and the lock-joint fastened to the tram-block on the bridge-tree, with the lever and weight acting on the same; the spindle passing through the balance-rind, secured to and suspended from the runner; the inserting wings or flights in the eye; the shape of the driver and balance-rind causing currents of air to pass between the stones in pipes or otherwise, and through grooves on the circumference of a hollow cylinder placed within the eye of the runner, carrying off the dirt and keeping the stones from heating, likewise causing a draft through the eye, which allows the grain to pass more freely to the grinding stones.

The mills are portable, and can be attached to any machinery, horse, steam, or water, with about two horse power, and are constructed on such a principle as to perform fast grinding with small stones, without heating the flour, and thereby greatly lessening the expense in erecting mills, and requiring much less power to grind them. The improvement can also be applied to mills now in use of the common construction. I am, Sir, yours, &c.

Gideon Hotchkiss.

[We are much obliged by Mr. Hotchkiss' communication: it is from such sources that we look with confidence for much valuable matter to enrich our columns. Mr. Hotchkiss possesses certificates of the utility of his invention from upwards of seventy practical men, including many millers and millwrights, who have witnessed the operation.—Ed. M. M.]

Cement for Glass or China.—An ounce of pure gum mastic is to be dissolved in q. s. of

well rectified alcohol, and the same quantity of ichthyocolla steeped in water till soft, and then dissolved in alcohol; these solutions are to be mixed, and a quarter of an ounce of gum ammoniac added. The whole is now to be exposed to a gentle heat till perfectly amalgamated, when it is to be poured into a vial and kept well corked. When it is to be used, both the vial and the vessel to be mended are to be warmed, and the united fragments should be pressed in close contact for at least twelve hours.—[Journ. des Connais. Usuel.]

On Heat—Its spreading by Conduction—Result of Experiments on Metals, Glass, Earths, Wood, Air, &c.—Admirable Adaptation of the Substances which Nature has provided as Clothing for Inferior Animals to the Wants and Conveniences of Man, &c. [From Dr. Arnott's Elements of Physics.]

If one end of a rod of iron be held in the fire, a hand grasping the other end soon feels the heat coming through it. Through a similar rod of glass the transmission is much slower, and through one of wood it is slower still. The hand would be burned by the iron before it felt warm in the wood, although the inner end were blazing.

On the fact that different substances are permeable to heat, or have the property of conducting it, in different degrees, depend many interesting phenomena in nature and in the arts: hence it was important to ascertain the degrees exactly, and to classify the substances. Various methods for this purpose have been adopted. For solids—similar rods of the different substances, after being thinly coated with wax, have been placed with their inferior extremities in hot oil, and then the comparative distances to which, in a given time, the wax was melted, furnished one set of indications of the comparative conducting powers: or, equal lengths of the different bare rods being left above the oil, and a small quantity of explosive powder being placed on the top of each, the comparative intervals of time elapsing before the explosions gave another kind of measure: or, equal balls of different substances, with a central cavity in each to receive a thermometer, being heated to the same degree and then suspended in the air to cool, until the thermometer fell to a given point, gave still another list. A modification of the last method was adopted by Count Rumford to ascertain the relative degrees in which furs, feathers, and other materials used for clothing, conduct heat, or, which is the same thing, resist its passage. He covered the ball and stem of a thermometer with a certain thickness of the substance to be tried, by placing the thermometer in a large bulb and stem of glass, and then filling the interval between them with the substance; and, after heating this apparatus to a certain degree, by dipping it in liquid of the desired temperature, he surrounded it by ice, and marked the comparative times required to cool the thermometer a certain number of degrees. The figures following the names of some of the substances in the subjoined list, mark the number of seconds required respectively for cooling it 60°.

These experiments have shown as a general rule, that density in a body favors the passage of heat through it. The best conductors are the metals, and then follow in succession diamond, glass, stones, earths, woods, &c. as here noted:

Metals—silver, copper, gold, iron, lead.	
Diamond.	
Glass.	
Hard stones.	
Porous earths.	
Woods.	
Fats or thick oils.	
Snow.	
Air	576
Sewing Silk	917
Wood ashes	927
Charcoal	937
Fine lint	1,032
Cotton	1,046
Lamp-black	1,117
Wool	1,118
Raw Silk	1,284
Beavers' fur	1,296
Eider down	1,305
Hares' fur	1,315

Air appears near the middle of the preceding list, but if its particles are not allowed to move about among themselves so as to *carry* heat from one part to another, it *conducts* (in the manner of solids) so slowly that Count Rumford doubted whether it conducted at all. It is probably the worst conductor known, that is, the substance which when at rest impedes the passage of heat the most. To this fact

seems to be owing in a considerable degree the remarkable non-conducting quality of porous or spongy substances, as feathers, loose filamentous matter, powders, &c. which have much air in their structure, often adherent with a force of attraction which immersion in water, or even being placed in the vacuum of an air pump, is insufficient to overcome.

While contemplating the facts recorded in the above table, one cannot but reflect how admirably adapted to their purposes the substances are which nature has provided as clothing for the inferior animals; and which man afterwards accommodates with such curious arts to his peculiar wants. Animals required to be protected against the chills of night and the biting blasts of winter, and some of them which dwell among eternal ice, could not have lived at all but for a garment which might shut up within it nearly all the heat which their vital functions produced. Now, any covering of a metallic or earthy or woody nature would have been far from sufficing; but out of a wondrous chemical union of carbon with the soft ingredients of the atmosphere, those beautiful textures are produced called fur and feather, so greatly adorning while they completely protect the wearers: textures, moreover, which grow from the bodies of the animals, in the exact quantity that suits the climate and season, and which are reproduced when by any accident they are partially destroyed. In warm climates the hairy coat of quadrupeds is comparatively short and thin, as in the elephant, the monkey, the tropical sheep, &c. It is seen to thicken with increasing latitude, furnishing the soft and abundant fleeces of the temperate zones; and towards the poles it is externally shaggy and coarse, as in the arctic bear. In amphibious animals, which have to resist the cold of water as well as of air, the fur grows particularly defensive, as in the otter and beaver. Birds, from having very warm blood, required plenteous clothing, but required also to have a smooth surface, that they might pass easily through the air: both objects are secured by the beautiful structure of feathers, so beautiful and wonderful that writers on natural theology have often particularized it as one of the most striking exemplifications of creative wisdom. Feathers, like fur, appear in kind and quantity suited to particular climates and seasons. The birds of cold regions have covering almost as bulky as their bodies, and if it be warm in those of them which live only in air, in the water-fowl it is warmer still. These last have the interstices of the ordinary plumage filled up by the still more delicate structure called down, particularly on the breast, which in swimming first meets and divides the cold wave. There are animals with warm blood which yet live very constantly immersed in water, as the whale, seal, walrus, &c. Now neither hair nor feathers, however oiled, would have been a fit covering for them; but kind nature has prepared an equal protection in the vast mass of fat or thick oil which surrounds their bodies—substances which are scarcely less useful to man than the furs and feathers of land animals.

While speaking of clothing, we may remark that the bark of trees is also a structure very slowly permeable to heat, and securing therefore the temperature necessary to vegetable life.

And while we admire what nature has thus done for animals and vegetables, let us not overlook her scarcely less remarkable provision of ice and snow, as winter clothing for the lakes and rivers, for our fields and gardens. Ice, as a protection to water and its inhabitants, was considered in the explanation of why, although solid, it swims on water. We have now to remark that snow, which becomes as a pure white fleece to the earth, is a structure which resists the passage of heat nearly as much as feathers. It, of course, can defend only from colds below 32° or the freezing point; but it does so most effectually, preserving the roots and seeds and tender plants during the severity of winter. When the green blade of wheat and the beautiful snow-drop flower appear in spring rising through the melting snow, they have recently owed an important shelter to their wintry mantle. Under deep snow, while the thermometer in the air may be far below zero, the temperature of the ground rarely remains below the freezing point. Now this temperature, to persons some time accustomed to it, is mild and even agreeable. It is much higher than what often prevails for long periods in the atmosphere of the centre and north of Europe. The Laplander, who during his long winter lives under ground, is glad to have additionally over head a thick covering of snow. Among the hills of the west and north of Bri-

tain, during the storms of winter, a house or covering of snow frequently preserves the lives of travellers, and even of whole flocks of sheep, when the keen north wind, catching them unprotected, would soon stretch them lifeless along the earth.

It is because earth conducts heat slowly that the most intense frosts penetrate but a few inches into it, and that the temperature of the ground a few feet below its surface is nearly the same all the world over. In many mines, even although open to the air, the thermometer does not vary one degree in a twelvemonth. Thus also water in pipes two or three feet under ground does not freeze, although it may be frozen in all the smaller branches exposed above. Hence, again, springs never freeze, and therefore become remarkable features in a snow-covered country. The living water is seen issuing from the bowels of the earth, and running often a considerable way through fringes of green, before the gripe of the frost arrests it; while around it, as is well known to the sportsman, the snipes and wild duck and other birds are wont to congregate. A spring in a frozen pond or lake may cause the ice to be so thin over the part where it issues, that a skater arriving there will break through and be destroyed. The same spring water which appears warm in winter is deemed cold in summer, because, although always of the same heat, it is in summer surrounded by warmer atmosphere and objects. In proportion as buildings are massive, they acquire more of those qualities which have now been noticed of our mother earth. Many of the gothic halls and cathedrals are cool in summer and warm in winter—as are also old fashioned houses or castles with thick walls and deep cellars. Natural caves in the mountains or sea-shores furnish other examples of a similar kind.

When in the arts it is desired to prevent the passage of heat out of or into any body or situation, a screen or covering of a slow conducting substance is employed. Thus, to prevent the heat of a smelting or other furnace from being wasted, it is lined with fire bricks, or is covered with clay and sand, or sometimes with powdered charcoal. A furnace so guarded may be touched by the hand, even while containing within it melted gold. To prevent the freezing of water in pipes during the winter, by which occurrence the pipes would be burst, it is common to cover them with straw ropes, or coarse flannel, or to enclose them in a larger outer pipe with dry charcoal, or saw dust, or chaff, filling up the interval between. If a pipe, on the contrary, be for the conveyance of steam or other warm fluid, the heat is retained, and therefore saved by the very same means. Ice houses are generally made with double walls, between which dry straw placed, or saw dust, or air, prevents the passage of heat. Pails for carrying ice in summer, or intended to serve as wine coolers, are made on the same principle—*viz.* double vessels, with air or charcoal filling the interval between them. A flannel covering keeps a man warm in winter—it is also the best means of keeping ice from melting in summer. Urns for hot water, tea pots, coffee pots, &c. are made with wooden or ivory handles, because if metal were used, it would conduct the heat so readily that the hand could not bear to touch them.

It is because glass and earthen ware are brittle, and do not allow ready passage to heat, that vessels made of them are so frequently broken by sudden change of temperature. On pouring boiling water into such a vessel, the internal part is much heated and expanded (as will be explained more fully in a subsequent page) before the external part has felt the influence, and this is hence riven or cracked by its connection with the internal. A chimney mirror is often broken by a lamp or candle placed on the marble shelf too near it. The glass cylinder of an electrical machine will sometimes be broken by placing it near the fire, so that one side is heated while the other side receives a cold current of air approaching the fire from a door or window. A red hot rod of iron drawn along a pane of glass will divide it almost like a diamond knife. Even cast iron, as backs of grates, iron pots, &c. although conducting readily, is often, owing to its brittleness, cracked by unequal heating or cooling, as from pouring water on it when hot. Pouring cold water into a heated glass will produce a similar effect. Hence glass vessels intended to be exposed to strong heats and sudden changes, as retorts for distillation, flasks for boiling liquids, &c. are made very thin, that the heat may pervade them almost instantly and with impunity.

There is a toy called a *Prince Rupert's Drop*, which well illustrates our present sub-

ject. It is a lump of glass let fall while fused into water, and thereby suddenly cooled and solidified on the outside before the internal part is changed; then as this at last hardens and would contract, it is kept extended by the arch of external crust, to which it coheres. Now if a portion of the neck of the lump be broken off, or if other violence be done, which jars its substance, the cohesion is destroyed, and the whole crumbles to dust with a kind of explosion. Any glass cooled suddenly when first made remains very brittle, for the reason now stated. What is called *Bologna jar* is a very thick small bottle thus prepared, which bursts by a grain of sand falling into it. The process of annealing, to render glass ware more tough and durable, is merely the allowing it to cool very slowly by placing it in an oven, where the temperature is caused to fall gradually. The tempering of metals by sudden cooling seems to be a process having some relation to that of rendering glass hard and brittle.

It is the difference of conducting power in bodies which is the cause of a very common error made by persons in estimating the temperature of bodies by the touch. In a room without a fire all the articles of furniture soon acquire the same temperature; but if in winter a person with bare feet were to step from the carpet to the wooden floor, from this to the hearthstone, and from the stone to the steel fender, his sensation would deem each of these in succession colder than the preceding. Now the truth being that all had the same temperature, only a temperature inferior to that of the living body, the best conductor, when in contact with the body, would carry off heat the fastest, and would therefore be deemed the coldest. Were a similar experiment made in a hot house or in India, while the temperature of every thing around was 98°, *viz.* that of the living body, then not the slightest difference would be felt in any of the substances: or lastly, were the experiment made in a room where by any means the general temperature was raised considerably above blood heat, then the carpet would be deemed considerably the coolest instead of the warmest, and the other things would appear hotter in the same order in which they appeared colder in the winter room. Were a bunch of wool and a piece of iron exposed to the severest cold of Siberia, or of an artificial frigioric mixture, a man might touch the first with impunity (it would merely be felt as rather cold); but if he grasped the second, his hand would be frost bitten and possibly destroyed: were the two substances, on the contrary, transferred to an oven, and heated as far as the wool would bear, he might again touch the wool with impunity (it would then be felt as a little hot,) but the iron would burn his flesh. The author has entered a room where the temperature from hot air admitted was sufficiently high to boil the fish, &c. of which he afterwards partook at dinner; and he breathed the air with very little uneasiness. He could bear to touch woollen cloth in this room, but no body more solid.

The foregoing considerations make manifest the error of supposing that there is a positive warmth in the materials of clothing. The thick cloak which guards a Spaniard against the cold of winter is also in summer used by him as protection against the direct rays of the sun: and while in England flannel is our warmest article of dress, yet we cannot more effectually preserve ice than by wrapping the vessel containing it in many folds of softest flannel.

In every case where a substance of different temperature from the living body touches it, a thin surface of the substance immediately shares the heat of the bodily part touched—the hand generally; and while in a good conductor, the heat so received quickly passes inwards, or away from the surface, leaving this in a state to absorb more, in the tardy conductor the heat first received tarries at the surface, which consequently soon acquires nearly the same temperature as the hand, and therefore, however cold the interior of the substance may be, it does not cause the sensation of cold. The hand on a good conductor has to warm it deeply, a slow conductor it warms only superficially. The following cases farther illustrate the same principle. If the ends of an iron poker and of a piece of wood of the same size be wrapped in paper and then thrust into a fire, the paper on the wood will begin to burn immediately, while that on the metal will long resist: or if pieces of paper be laid on a wooden plank and on a plate of steel, and then a burning coal be placed on each, the paper on the wood will begin to burn long before that on the plate. The explanation is, that the paper in contact with the good conductor loses to this so rapidly the heat received from the coal, that it remains

at too low a temperature to inflame, and will even cool to blackness the touching part of the coal; while on the tardy conductor the paper becomes almost immediately as hot as the coal. It is because water exposed to the air cannot be heated beyond 212°, that it may be made to boil in an egg-shell or a vessel made of paper, held over a lamp, without the containing substance being destroyed; but as soon as it is dried up, the paper will burn and the shell will be calcined, as the solder of a common tinned kettle melts under the same circumstances. The reason why the hand judges a cold liquid to be so much colder than a solid of the same temperature is, that, from the mobility of the liquid particles among themselves, those in contact with the hand are constantly changing. The impression produced on the hand by very cold mercury is almost insufferable, because mercury is both a ready conductor and a liquid. Again, if a finger held motionless in water feel cold, it will feel colder still when moved about; and a man in the air of a calm frosty morning does not experience a sensation nearly so sharp as if with the same temperature there be wind. A finger held up in the wind discovers the direction in which the wind blows by the greater cold felt on one side; the effect being still more remarkable, if the finger is wetted. If a person in a room with a thermometer were with a fan or bellows to blow the air against it, he would not thereby lower it, because it had already the same temperature as the air, yet the air blown against his own body would appear colder than when at rest, because, being colder than his body, the motion would supply heat-absorbing particles more quickly. In like manner, if a fan or bellows were used against a thermometer hanging in a furnace or hot-house, the thermometer would suffer no change, but the air moved by them against a person would be distressingly hot, like the blasting sirocco of the sandy deserts of Africa. If two similar pieces of ice be placed in a room somewhat warmer than ice, one of them may be made to melt much sooner than the other, by blowing on it with a bellows. The reason may here be readily comprehended why a person suffering what is called a cold in the head, or catarrh from the eyes and nose, experiences so much more relief on applying to the face a handkerchief of linen or cambric than one of cotton: it is that the former by *conducting* readily absorbs the heat and diminishes the inflammation, while the latter, by refusing to give passage to the heat, increases the temperature and the distress. Popular prejudice has held that there was a poison in cotton.

Iron Boats—*Expedition to the Niger.*—Extract of a letter from Mr. Richard Lander, dated Isle de Loz, Coast of Africa, Sept. 6, 1832, on board the Quorra Steamer:—"I write merely to inform you we arrived here on the 3d instant, all well, and leave for Cape Coast this evening. All the vessels have behaved very well. We have had several tornadoes: the lightning was felt more on board the Quorra than the iron steamer; it remained on our decks, but it merely struck the sides of the latter, and glided off into the water. This will give you an idea that an iron vessel is even safer than one built of wood. On board the Quorra we suffer much from the smell of bilge water, while the iron boat has not made one inch of water since she sailed from Liverpool, and she is never warmer than the water she floats in."

Mr. Berrian's Invention for propelling Carriages over Hills on Inclined Planes. [Communicated by the Inventor, for the Mechanics' Magazine.]

A new and useful improvement, made by Richard Berrian, of the city of New-York, on Wheels and Axles of the Locomotive Engine, as well as the Rails on the Roads, for the purpose of propelling Cars and Carriages over Hills and Mountains, on Inclined Planes, by means of Wheels or Segments, cogged, and attached to the sides of the large Wheels. The rails may be on either side of the wheels, rising sufficiently high for the cogs to reach and run into each other. The rails must be laid down cogged, and fitted to receive the cogged wheel at the foot of the hill, or at any of the inclined planes intended for that purpose; or, you may lay down a cogged rail in the centre of those two that have already been laid down, or may hereafter be laid down, at the rise or elevation of a hill or mountain requiring the same to be done; or, you may place a stationary cogged wheel on the centre of the axle, to receive the cogged segment on the centre rail, then pass the ends of the axle through

the boxes in the hubs of the wheels, cranked at the ends, so that they may be taken off or on, as occasion may require. The axle passing through the large wheels may revolve or not, as may suit best; or you may place boxes for the axle to run in under the floor of the locomotive engine, when more convenient. As a substitute for the locomotive engine, with a train of cars or carriages, going down hill, if it should be found necessary so to do, place stationary sheeves or circular knobs on or near the axle, for a rope to turn round on, or either or all of them: after having fastened the rope well at the bottom of the hill, then run it up to the top, and take a round turn over one or more of those knobs or sheeves that are fastened under the cars, carriages, or engine; when on the hill, hook the other end of the rope to a windlass placed there for the purpose of a regulator, keeping the rope taut. Or, if the rope is run round the windlass knobs or sheeves, and hooked or fastened to the cars or carriages, a boy of fifteen years of age can take them down with ease, and that without injury.

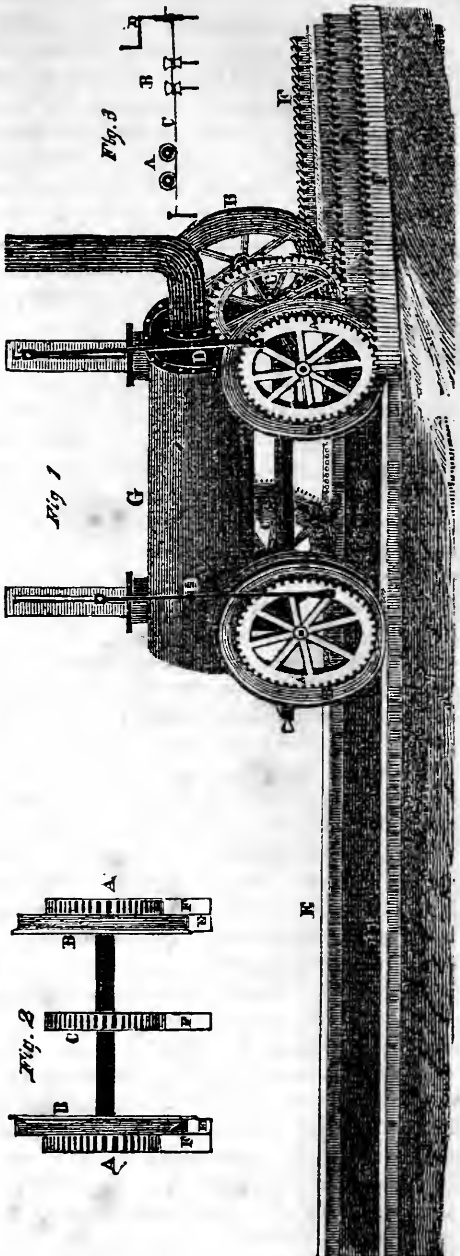
The power gained on this principle is double that of any former ones—it will ascend and descend Hills and Mountains, on inclined planes, at the most freezing and slippery season of the year. If this principle was adopted, thousands and tens of thousands of dollars might be saved, by preventing the necessity of levelling hills and rocks—a circumstance that deters many companies from being formed. The power gained on this principle is in proportion to the diameter of the small cogged wheels and the cranks that are on the axles, which turn the same. The Locomotive Engine may either run on the double or single rails cogged.

REFERENCES.

Fig. 1. A A, Segments or Wheels cogged—B B, Original or common Wheels—C C, Centre Wheel cogged—D, Body of the Engine—E, Centre Rail cogged—F F, Two outside rails cogged.

Fig. 2. Shewing the same as Fig. 1, in an erect position.

Fig. 3. Represents the apparatus for taking a train of carriages down hill, or on an inclined plane—A, Sheeves, stationary, on the axle or under the engine—B, Circular Knobs, stationary, at the top of the hill—C, Cord or Rope, or Chain—D, Windlass at the top of the hill—E, Post at the foot of the hill to fasten the rope or chain.



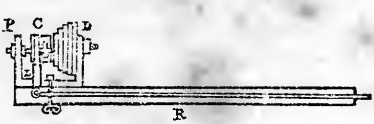
N. B.—If any thing should give way in going up or down hill, the Patentee has also a safety-guard, that will stop itself and the whole train of cars in an instant: the advantages of which will more fully appear by examining the model or drawing. Richard Berrian, Patentee.

New-York, 1832.

A Mathematical Prodigy.—As an antidote to the prejudice existing against precocity of intellect, which so often blazes for a moment and then expires, or sinks into obscurity, we may justly adduce the splendid recollections which attach to the names of a Crichton, a Mirandola, a Newton, a Mozart, and many others, whose premature "beauty of mind" has expanded into the happiest maturity. There is every such promise as this about a Sicilian boy of the present day, whose powers and brief parentage [?] are dwelt upon in the following extract of a letter from Rome:

"The boy, Joseph Puglisi, who has just arrived here from Palermo, the place of his birth, is indeed blessed, as all who have heard and observed him must admit, with the most extraordinary natural endowments. You shall judge for yourself of their extent. He is the son of a glove maker in Palermo. The first evidence he gave of his intellectual powers occurred about eighteen months ago, when he had just completed his sixth year. The occasion was this: an agent having purchased a quantity of gloves from several different individuals, Puglisi's father went to fetch him pen and ink, with a view to find the sum total of the man's purchases; but his urchin of a son, who was at the time in the shop, called after him that he need not give himself the trouble, as the whole amount was so many ounces and odd. Being asked who had told him so, he replied, "My own head." On summing up the several items, his calculation was found to be perfectly correct. From this moment his arithmetical powers were put to repeated tests; and they were put into still further action by increasing the difficulty of the questions set him, which he solved under the gradual exhibition of a talent of far superior calibre. His father then came with him to Catanea, brought him under the notice of the Viceroy of Sicily, and afterwards set off for Naples, where young Puglisi produced his parent a golden harvest, besides acquiring an increase of fame to his own share. Thence he found his way to this place, where he has been an object of astonishment and admiration in every circle, and has been honored with a handsome gold medal by the Pope himself. You can conceive nothing so astonishing as the boy's capacity for all sorts of arithmetical calculations, whether they be of the most trivial or the abstrusest nature. His genius consists in his being perfectly sensible of its pre-eminence, wielding it with masterly clearness and precision, and at times bringing it to bear with surprising effect. Hence it is, that he is enabled to state the process through which he arrives at once at his solutions, and, at the same time, to explain the difficulties which have attended them. All this is done without any aid from science; for, with the exception of a knowledge of figures, he can neither read nor write. For instance, on his being asked a particular question, it was necessary to explain what a square root was to him, and after that he instantly gave his answer with minute accuracy. I heard him in public yesterday: ten questions of various degrees of difficulty were set him, and he solved them all without hesitation or blunder. It was really a most interesting scene. The boy sat at first looking about him with a laugh and a smile, obviously flattered at being the subject of attention to so numerous an auditory; but no sooner was the first question started than his whole frame underwent a change as instantaneous as the sensitive plant, when the slightest touch affects it. Whilst brooding over it, he played with his hands, moved his body backwards and forwards, and was constantly shifting himself about on his seat. There was evidence irrefragable of every motion of the internal working of the '*mens alvina.*' On a sudden he sprang from his seat, in a state of indescribable ecstacy, and with eyes sparkling with fire, and exulting at his triumph, announced the result in a strong and melodious tone of voice. I must leave you to imagine the effect which all this produced upon us. And the same scene was repeated at every fresh question and solution. Two of them were stated in so confused a manner that not a soul in the room could comprehend them; at the second, the boy rose from his seat, and much to our diversion, exclaimed, with his broad good humored Sicilian, '*Lo saccio ben fare, ma essi non sanno domandare,*' (I am perfectly able to solve the thing, but they do not know how to put the question.) He was asked if a certain quantity of water be contained in the Tiber, and eight men were employed to remove it, how many days would they consume in the operation? Upon this the lad inquired, almost before the words were out of the questioner's mouth, 'You have

forgotten to state what quantity they bale out every day or hour.' As soon as the hiatus was supplied, in less than three minutes our young arithmetician stood up with the result, which involved some millions of figures. In person he is of middling size for his age, and between robust and slender of make; his complexion is sallow, his hair light-colored, and his eyes blue, though without any particular expression of liveliness or animation; his look, however, is soft, wary, and tranquil."—[Philadelphia Gazette.]



Improvement in the Lathe, by which the work in hand may be examined without stopping. By J. Walker. [From the London Mechanics' Magazine.]

Sir,—In driving the foot lathe I have always found the hardest part of the labor to be the stopping occasionally to examine the work, and then starting anew. To obviate this difficulty I have invented the improvement represented in the accompanying sketch, which, as far as my knowledge extends, is new.

P shows the poppet head with riggers; D the dividing plate, fixed on the mandril with a small collar betwixt it and the riggers; C a small clutch box; L the lever; R a small rod supported at the far end of the bed, connected to C, which enables the turner to throw the riggers out and in gear; allowing them to run loose upon the mandril, so that when examining your work the fly wheel may still go on.

If any of your readers are aware of any similar contrivance, I should be glad to be made acquainted with it, as I am about fitting up a new turning apparatus with the improvement just described.

A GLOSSARY OF MECHANICAL TERMS.

[Continued from page 53.]

Eccentric—Deviating from the centre; as cambs, attached to the rim or circumference of a shaft for lifting forge hammers, stampers, &c.

Effective-head—The real head, or that which can be applied to practice.

Effluent—Flowing from; running out.

Efflux—The act of flowing out.

Epicycloid—The curve described in the air by a point on the circumference of a circle, when this circle rolls on another circle as its base.

Equilibrium—That peculiar state of rest in which a body is maintained by the force of gravitation, when the quantity of matter in it is exactly equal on each side of the bar or point on which it is supported.

Escapement—The part of a clock or watch movement which receives the force of the spring or weight to give motion to the pendulum or balance.

Face of the tooth—The curved part of a tooth which imparts impulse to another wheel.

Faggot—Pieces of iron bound together for remanufacture.

Fan—Small vanes or sails to receive the impulse of the wind, and, by a connexion with machinery, to keep the large sails of a smock wind-mill always in the direction of the wind; an instrument to winnow corn; also to decrease speed by its action on the air.

Female-screw—The spiral threaded cavity in which a screw operates.

File—A tool used by smiths for the abrasion of metals, denominated, according to its fineness, rough, bastard, or smooth.

First-mover—Power, either natural or artificial.

Flanch—An edge or projection for the better connexion of piping or castings of any description.

Flank of the tooth—The straight part of a tooth which receives impulse from another wheel.

Float—The board which receives the impulse of the water either in breast or undershot-wheels.

Floodgate—A strong framing of timber to pen back or let out water.

Flux—Ingredients put into a smelting furnace to fuse the ore of metals.

Fly-wheel—A heavy wheel to maintain equable motion.

Foot-brake—A machine used in the flax manufacture.

Forge—A manufactory in which metals are made malleable; a furnace.

Forge—To form by the hammer.

Friction—Inequality of surface; act of rubbing together.

Frisket—An iron frame used in printing to keep

the sheet of paper on the tympan, and to prevent the margin from being blackened.

Fulcrum—The point or bar on which a lever rests.

Geering—Part of mill-work.

Gibbet—That part of a crane which sustains the weight of goods.

Gig-mill—A mill in which the nap of woolen cloth is raised by the application of teasels.

Girder—The largest timber in a floor.

Girt—*Vide* Gripe.

Gravity—Tendency towards the centre of the earth ; weight.

Gripe—A pliable lever which can be pressed against a wheel to retard or stop its motion by friction.

Governor—A pair of heavy balls connected with machinery to regulate the speed on the principle of central force.

Gudgeon—The centres or pivots of a water-wheel.

Half-stuff—This term, in general, implies any thing half-formed in the process of the manufacture.

Heald or Heddle—*Vide* Heddle.

Heckle—A metal comb for the manufacture of flax.

Heddle—That portion of a loom which imparts motion to the warp of a web during the process of manufacture.

Helve—The shaft of a forge or tilt-hammer.

Hopper—A funnel in which grain is deposited, whence it runs between the stones of a flour-mill.

Horology—The art of constructing machines for measuring time.

Hydraulics—The science which treats of the motion of fluids, of the resistance which they oppose to moving bodies, and of the various machines in which fluids are the principal agent.

Hydrodynamics—The science which embraces the phenomena exhibited by water and other fluids, whether they be at rest or in motion: it is generally divided into two heads, hydrostatics and hydraulics.

Hydrostatics—The science which considers the pressure, equilibrium, and cohesion of fluids.

Impact—Transmission of force.

Impinge—To dash against.

Inertia—That tendency which every piece of matter has, when at rest, to remain at rest; and when in motion, to continue that motion.

In vacuo—Empty space, void.

Isochronal—Of equal duration.

Isochronous—The vibrations of a pendulum.

Jenney—A machine used in the process of the cotton manufacture.

Jib—*Vide* Gibbet.

Kiln—A place where bricks are burnt.

Kink or Kinkle—The entangling of cordage from overtwisting.

Lateral—A horizontal or lengthwise movement.

Lathe—Machine used by turners.

Lantern—A wheel with staff-teeth ; the trundle or wallower.

Leaves—The teeth of a pinion.

Lever—One of the mechanical powers.

Line of centres—A line drawn from the centre of one wheel to the centre of another, when their circumferences touch each other.

Locomotive—The power of changing place.

Loom—A machine used by weavers in the making of cloth.

Machinist—One who makes machines.

Mandrel—Part of a lathe; cone used by smiths; a cylindrical piece of polished iron or steel put down the core or hole of a pipe during the process of elongation.

Mastering—Preparation of lime used by tanners.

Matrice—The concave form of a letter in which the types are cast.

Maximum—Is the utmost extent of any movement or power.

Mechanist—One acquainted with the laws of mechanics.

Mill-head—The head of water which is to turn a mill.

Mill-tail—The water which has passed through the wheel-race, or is below the mill.

Minimum—The reverse of maximum.

Momentum—The force possessed by matter in motion.

Monkey—A weight or mass of iron let fall from a height to drive piles into the earth.

Mortise—A joint.

Movement—The working part of a watch or clock.

Nave—The centre, or that part of a wheel in which the spokes or arms are fixed.

Nealing—*Vide* Annealing.

Nippers—Pincers with cutting edges for dividing metals.

Nitric acid—A corrosive acid extracted from nitre.

Ouse—Preparation of bark used by tanners.

Overshot-wheel—A wheel which receives the water in buckets at not more than 45 degrees from the apex.

Oxyd—A combination of oxygen with a metallic or other base.

Oxygen—A gas which supports combustion.

Paddle—A kind of oar; floats to a wheel.

Pall—A small piece of metal which falls between the teeth of a ratchet-wheel, to prevent a load which has been raised from descending when the operative power is removed.

Pallet—That part of a watch or clock escapement on which the crown-wheel strikes.

Pendulum—A weight suspended by a flexible cord to an axis, so as to swing backwards and forwards, when once raised, by the force of gravitation.

Periphery—The circumference of a wheel.

Perpendicular—At right angles to a given base.

Pick—A chisel for dressing the stones of a flour-mill.

Pile—A large piece of timber, pointed at one end, to drive into the earth to sustain the piers of bridges, &c.

Pin—To strike a piece of metal with the narrow end of a hammer to form dents and produce elongation.

Pincers—A tool formed by placing two levers on one fulcrum, regulated by a screw-movement, for holding bodies firmly.

Pinion—A small toothed wheel.

Pirn—The wound yarn that is on a weaver's shuttle.

Piston—A plug made to fit tight and work up and down a cylinder in hydraulic engines.

Pitch-lines—The touching circumference of two wheels which are to act on each other.

Pitch of the wheel—The distance from the centres of two teeth, measured upon their pitch line.

Pivot—A short shaft on which a body turns or vibrates.

Platina—A white metal capable of withstanding great heats.

Pliers—A small tool constructed similarly to pincers.

Plumb—A leaden weight suspended by a cord to ascertain the perpendicular.

Plunger—A body that is forced into a fluid in hydraulic engines, to displace its own weight.

Portable steam-engine—A steam-engine built in a compact form, and not attached to the wall of the building in which it works.

Proportional circles—*Vide* Pitch-lines.

Proportional radii—The radii of two circles whose circumferences are in contact.

Pudding—The act of ramming with clay to arrest the progress of water.

Pudding-furnace—A furnace used in the iron manufactures.

Pulley—A small wheel over which a strap is passed.

Quintal—A French or Spanish weight equivalent to 100 lbs. of those respective nations.

Rabbit or Rap-it—The strong wooden spring against which the forge hammer strikes on its ascent.

Race—The canal along which the water is conveyed to and from a water-wheel.

Rack—A straight bar which has teeth similar to those on a toothed wheel.

Radii—The plural of radius.

Radius—The semi-diameter of a circle; the arm or spoke of a wheel.

Rasp—A species of file, on which the cutting prominences are distinct, being raised by a point instead of an edge.

Rasure—The act of scraping.

Ratch—A bar containing teeth into which the pall drops to prevent machine running back.

Ratchet-wheel—A wheel having teeth similar to those of a ratch.

Reciprocating—Acting alternately.

Rectilinear or rectilineal—Consisting of right lines.

Reed—Part of a loom, resembling a comb, for dividing the warp.

Regulator—A small lever in watch-work, which, by being moved, increases or decreases the amount of the balance spring that is allowed to act.

Reel—A frame on which yarn may be wound.

Reeling—The act of winding yarn on a reel.

Resolution of forces—*Vide* "Of the Action of Forces."

Reservoir—A large basin or conservatory of water.

Reverberatory—Beating back.

Reverberatory-furnace—A furnace used in the iron and copper manufactures.

Rivet—To form a head by the percussion of a hammer, to prevent a piece of metal which has been passed through an orifice, to connect things together, from returning.

Roller-gin—A machine to divest cotton of the husk and other superfluous parts, previous to the commencement of the manufacture.

Rotatory—Revolving.

Rowans—Cotton in that part of the manufacture before it goes to the roving frame.

Rubber—A heavy file used for coarse work.

Rubble—A mode of building;]*vide* Masonry, p. 98, vol. ii, of Nicholson's Op. Mec.]

Rynd—The piece of iron that goes across the hole in an upper mill-stone.

Safety-valve—A valve which fits on the boiler of a steam-engine to guard against accidents by the steam obtaining too high a pressure.

Saw-gin—A machine on the principle of the roller-gin.

Scantling—The length, breadth, and thickness of any solid body taken lineally.

Scapement—*Vide* Escapement.

Scotching—The operation of packing hemp before it goes to the market.

Scoria—Slag from a smelting furnace.

Scowering-barrel—An octagonal, or other shaped barrel, in which scrap-iron, &c. is cleansed from rust by friction as it revolves.

Scrap-iron—Various pieces of old iron to be remanufactured.

Screw—One of the mechanical powers.

Screbbler-engine—An engine used in the process of the cotton manufacture.

Shaft—A long piece of wood, or metal, on which large wheels are fixed in mill-work.

Sheeve—A small kind of pulley.

Shoulder—A support by means of a projection from a surface.

Shrouding—The boards, &c. which form buckets of water-wheels.

Shuttle—An arrangement to allow or shut off water from a water-wheel; a small piece of wood which carries the thread in weaving.

Size—Gelatinous matter made from animal or vegetable substances, and applied to fibrous materials to impart stiffness.

Slag—Scoria, or refuse from an iron furnace.

Sledge-hammer—A heavy hammer, used by a smith with both hands.

Slip—Potter's clay of the requisite consistency.

Sluice—Vent for water; a kind of flood-gate.

Snail movement—An eccentric.

Solder—Various compounds of metals for conjoining other metals that are less fusible than such compound.

Sparables—From sparrow-bill, small nails to drive into shoes.

Spatala—A thin knife, used mostly to extend superficially some semi-fluid matter.

Spindle—A thin piece of wood or steel on which yarn is wound after it has been twisted; a small kind of shaft.

Spokes—The radial pieces which connect the periphery of a wheel with its centre-piece or nave: this term is only applied to carriages.

Spring—An elastic body formed of metal or wood.

Spring-arbor—The arbor or spring round which the main spring of a watch is wound.

Spring-box—The box which contains the main spring.

Spur-geer—Wheels whose axes are parallel to each other.

Splice—To conjoin lengthwise two flexible pieces: by the interposition of their respective parts, so as to maintain them in conjunction by friction.

Staff—The teeth of a trundle, lantern, or wallower.

Staking-on—To drive wedges in the bush of a wheel or pulley, to fix it firm on a shaft or spindle.

Start or strut—The partitions which determine the form of a bucket in an over-shot wheel; the shoulder or wrest.

Staves—The plural of staff.

Steam-boat—A boat moved by steam power.

Steam-engine—A machine for applying the force of steam to create motion.

Steel-yard—A machine which denotes the weight of bodies by placing them at different distances from its fulcrum.

Stereotype—The art of casting solid plates from moveable types, to print from.

Strike—A thing used to strike any thing level in a measure; the strickle.

Strata—The plural of stratum.

Stratum—A single layer or bed of any one thing.

Stuff—This term is applied to an infinite variety of things; wood is, by the carpenter, called stuff, so is lime and hair by the bricklayer, and plaster by the plasterer, &c.

Swag—An unequal or hobbling motion.
Swifts—The rapid movement in a carding machine.
Swingling—*Vide* Scotching.
Swing-tree—Any beam that vibrates.
Swivel—A thing fixed in another body to turn round upon.
Syphon—A bent tube with unequal legs, through which a fluid will flow by the force of gravity.
Tail-water—Water which impedes the water-wheel in mill work.
Tank—Reservoir for water, &c.
Teasels—Thistles used to raise the nap of cloth in the gig-mill.
Tenon—That part which fills up the mortise.
Tilt-hammer—A hammer lifted by machinery, to force iron or steel.
Treadle—A lever affixed to a crank which communicates motion to machinery by a foot movement.
Throwsting—Spinning.
Triblet—*Vide* Mandrel.
Truckles—Small rollers for diminishing friction.
Trundle—A small wheel with staff teeth; the lantern or wallower.
Tuyere or Tue-iron—An orifice through which a blast or strong current of air is passed into forges.
Tympan—That part of a printing-press on which the paper is laid to receive the impression.
Undershot-weeel—A wheel acted on by water below its centre.
Vacuum—Void of air.
Valve—A cover to an aperture, in hydraulic machines, to prevent fluids taking a wrong course.
Vane—A flat surface capable of being moved by the current of a fluid; as, for instance, the vanes of a wind-mill, moved by the wind.
Tappets—Projections on the plug-tree of a steam-engine, which open and shut the valves at proper intervals.
Varnish—A solution of certain resinous bodies in spirits or oils, which assumes a solid form on dissication.
Velocity—The measure of quickness with which a body moves.
Vertical—Perpendicular to the horizon.
Vibration—Rapid alternating motion.
Virtual head—The real or effective head.
Vis-inertia—*Vide* Inertia.
Wabble—A hobbling unequal motion.
Wallower—Small wheel with staff teeth; the trundle or lantern.
Warp—The layer of threads which extends the length of the piece to be woven.
Washers—Small pieces of metal placed under a nut to reduce friction.
Water-wheel—A wheel which receives its impulse from water.
Weathering—The angle at which the sails of a wind-mill are set, to receive the impulse of the wind.
Wedge—An angularly shaped piece of wood or metal; one of the mechanical powers.
Weft—*Vide* Woof.
Weight—The measure of the amount of the attraction of gravitation in any body compared with that of other bodies.
Welding—The property of a conjunction possessed by some metals at high temperatures.
Wheel and Axis—One of the mechanical powers.
Wheel-race—The place in which a water-wheel is fixed.
Whip—To bind two rods together with small twine; the length of the sail of a wind-mill measured from the axis.
Whirl—A rotatory motion with a decreasing speed.
Winch—The lever or handle to which force is applied in machines turned by manual labor.
Wiper—An eccentric.
Wire-draw—To reduce any longitudinal body exceedingly in the transverse section; rapid passage of a fluid through a conical orifice.
Woof—Those portions of thread or yarn in cloth, which lie across the length of the warp.
Wrest or Wrist—The partitions which determine the form of the bucket in an overshot wheel; the start or shoulder.
Yarn—The combination of fibrous materials into a linear form by torsion.

A MILLION OF FACTS—*By Sir Richard Phillips.*—Among the clever books recently received from London, is one with the above title, containing a vast variety of information in a small space. It has been announced for publication by Mr. Conner, of New-York.

The sea is to the land, in round millions of square miles, as 160 to 40, or as 4 to 1.

Fraimhoifer, in his optical experiments, made a machine in which he could draw 32,900 lines in an inch breadth.

There are 7,700 veins in an inch of colored mother-of-pearl. Iris ornaments of all colors are made by lines of steel from 200 to the $\frac{1}{1000}$ part of an inch.

Bodies are transparent, says Newton, when the pores are so small as to prevent reflection.

The apprehension of the failure of a supply of coals in England is delusion. In Yorkshire alone, there are exhaustless beds, which are sold at 4s. or 5s. per ton.

The coal mines, which in Staffordshire have been burning for 200 years, consist of pyrites, subject to spontaneous combustion. Water will not extinguish them, because when drawn off, or absorbed, the pyrites burn more than before.

The odorous matter of flowers is inflammable, and arises from an essential oil. When growing in the dark their odor is diminished, but restored in the light; and it is strongest in sunny climates.

A chesnut tree grew at Tamworth, which was 52 feet round; it was planted in the year 800; and in the reign of Stephen, in 1135, was made a boundary, and called the great chesnut tree. In 1759, it bore nuts which produced young trees.

Botanists record 56,000 species of various plants; and 38,000 are to be found in the catalogues.

The height of mountains in the moon is considerable; ten are five miles or nearly; and eight are from 3 to 4 miles. Three of the hollows are from 3 to 4 miles; ten are from 2 to 3 miles, and as many are nearly 2 miles.

Teeth are phosphate of lime and cartilage, but the enamel is without cartilage.

The muscles of the human jaw exert a force of 534 pounds, and those of mastiffs, wolves, &c. far more. The force is produced by the swelling of the muscles in the middle, and dilating again.

The number of ribs vary, being twelve or thirteen on a side.

Peculiar Method of Turning Wool into Fur.—The wool-growers of Podolia and the Ukraine, and also in the Asiatic province of Astrachan, have a peculiar method of turning wool into fur. The lamb, after a fortnight's growth, is taken from the ewe, nourished with milk and the best herbage, and wrapped up as tight as possible in a linen covering, which is daily moistened with warm water, and is occasionally enlarged as the animal increases in size. In this manner wool becomes soft and curly, and is by degrees changed into shining beautiful locks. This is the kind of fur which passes under the name of Astrachan, and is considered on the continent as the most genteel lining in winter cloaks. Similar trials with German sheep have been attended with the same success. The Saxon breed of sheep have, within the last ten years, superceded the merino, and their wool is of superior quality.

New Electro-Magnetic Experiment.—Professor Emmet, of the University of Virginia, has succeeded in so arranging the horse-shoe magnet as to enable him to obtain, at pleasure, brilliant scintillations, nearly as perfect as those produced by the flint and steel. The most remarkable discovery, however, is a sure mode of giving strong and even unpleasant shocks, which bear great resemblance to those from a voltalic pile of about 100 pairs of plates. Some other results, tending to show that this new force has properties intermediate between those of Electricity and Galvanism, have been obtained and will shortly be made public.—[National Gazette.]

Cotton Manufactures in the State of New-York.—The following statement was furnished to the American Advocate by Mr. Williams, Editor of the N. Y. Annual Register, and one of the Committee appointed by the late Tariff Convention to ascertain the facts here presented:

There are in the State of New-York, 112 Cotton Manufactories.

Amount of capital invested, $4,485,500.

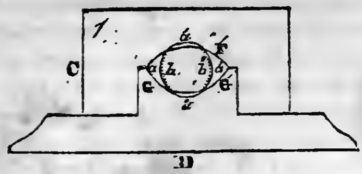
Goods manufactured yearly, valued 3,530,250.

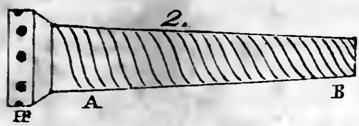
Amount of cotton used annually, 7,961,670 lbs. Equal to 26,539 bales of 300 lbs. each.

Number of spindles in use, 157,316.

Number of persons employed and sustained by said establishments, 15,817.

[Jour. of Com.]





New Modification of the Power of the Screw. By Φ. M. [From the London Mechanics' Magazine.]

The printer has made an erroneous substitution of "c 200 and *d* 200" for "c 201 and *d* 200," in the article describing my proposed improvement of Hunter's screw-press, which has, I fear, rendered that article somewhat unintelligible. Before I proceed to notice the figures above, I beg to remind those who may take the trouble to read the article alluded to, that, as I stated, the construction given is not the best of several; I have one in reserve, which meets two capital objections, which I anticipated as likely to be urged against the practical utility of the improvement—one, the great apparent increase of friction, the other the danger of the square production of the screw twisting under a very severe strain. I beg to add further, that I estimate the power of the press, according to the data given, at upwards of 20,000 tons.

The prefixed figures represent what, I believe, is quite a new modification of the power of the screw; and one which will produce a greater amount of power, at less expense of friction, and with less complexity of construction, than any other. As the common screw is familiarly considered as a wedge applied to the circumference of a cylinder, so this may be viewed as a wedge applied to the circumference of a frustum of a cone, and may be called a conic or wedge-screw. AB is such a screw, tapering from A to B, and having precisely the same interval between all the turns of the thread. The head is furnished with holes for handspokes to work the screw with. CD is the nut, formed in two parts, which separate easily. The eye of the nut is a frustum of a hollow cone, accurately similar to the smaller extremity of the screw, as far as regards the angular inclination of the sides of each to their respective axes, as seen in a longitudinal section; but different in this, that when the screw is inserted into the nut, the former is only a tangent to the latter. When the screw is inserted and worked round, it gradually forces the parts of the nuts asunder until the thicker end has come between them, when the surfaces of the nut and screw must be found to coincide.

In the figure the arcs F F′ and G G′ are arcs of a sectional circumference of the thickest part of the screw. A section of the smaller end is seen as inserted in the nut; the dotted circle *b b′* is a section of the body of the screw, and the outer circle, *a a′*, &c. is one of the threads of the screw, partly seen, and partly hid by its engagement in the nut. This screw seems equal to any thing, either as a producer of force, or as a measurer of minute distances: it seems also to have this peculiar advantage, that the smaller the angle of inclination of the sides, viz. the greater the power exerted, the more the threads are relieved from the burden of the pressure. As a mover of weight, the following estimate may be made of its power:—

Taking the length of the screw at 3 feet, independent of what enters the nut before action, the number of threads in that length as 30, the distance from the centre of the head to the end of the handspoke at 4 feet, and the difference of the diameters of the greater and less ends at 1 inch, then the resultant power will be about 259,500 lbs. or upwards of 115 tons, taking the working-power at 30 lbs.

As a micrometer, I beg to add the following estimate of its performance:—

Taking the length of a quarter degree on a common seaman's quadrant at $\frac{1}{20}$ of an inch, the length of the conic screw at 1 inch, the difference of the sectional diameters of the ends of the screw, and $\frac{1}{20}$ of an inch, and supposing the head of the screw to be divided into 100 parts on its limb; then we shall have a degree divided to the $\frac{1}{8000}$th part, or into less than half-seconds, supposing the thread to make 20 turns in the inch.

Earthquakes.—Among the novelties of the times, says the London Correspondent of the Journal of Commerce, are to be included some severe shocks of an earthquake felt at Swansea, and the surrounding country, to the distance of thirty miles. There were three shocks, the first having occurred on 28th December. This

was rather slight, and principally felt towards the coast. The second occurred on the following day, early in the morning, and was felt by every person either asleep or awake.

The third excited considerable alarm, and took place about 8 o'clock on the subsequent morning. The bells rung in many of the churches and houses—chimnies were thrown down—walls gave way—several houses opened, from their roofs to the ground, nearly an inch in width—many sunk from two to four feet, and all vibrated in such a manner that their fall was momentarily expected. It lasted almost four seconds, and was accompanied by a sound which is described to have been 'truly terrific.'

You will no doubt remember that when the great earthquake destroyed Lisbon in 1775, the Swansea river presented most striking phenomena. Perhaps these shocks are dependent upon some dreadful catastrophe, at a distance, and which time alone will enable us to ascertain. In this instance it was followed by a gale, which proved destructive to several vessels; one was seen to disappear, though a moment previously it was observed gliding rapidly over a slight sea. Many families have left Swansea, fearful that a more serious earthquake will take place, and those who have been compelled to remain are described as suffering very much from dread.

Railroads for the Application of Human Power. By Publicola. [From the American Railroad Journal, &c.]

The force of traction necessary to propel a ton weight on a level railroad is about eight pounds; or, in other words, a man can propel a ton weight on a level railroad as easily as he can walk on that road, and draw up eight pounds over a pulley. To surmount an ascent 66 feet in a mile would require in addition the force necessary to raise 28 pounds over a pulley. But as we know better how much a man may actually draw on a common road, the proposition may be stated thus: that a man may propel one ton on a level railroad as easily as he can draw 112 lb. on a common road. It will not be extravagant then to assume that a man may propel one ton weight on such railroads as it would be practicable to make in our country. To make a railroad with the tracks but $3\frac{1}{2}$ feet apart, sufficiently strong to sustain cars holding but one ton each, and moved by human strength, would not cost a large sum per mile. I venture to calculate that if such railroads should come into extensive use, they would not cost for double tracks more than 2000 dollars a mile on an average.

But would they answer any purpose as channels of trade? Let us see. If there should be a steady stream of cars, each containing one ton, and moving over the railroad at the rate of but two miles an hour, and ten rods apart, 600 tons might pass over in ten hours, and then, excepting the sabbaths, at this rate 187,800 tons might pass over in a year; and on the supposition that a large city has ten such routes entering it from the country, 1,878,000 tons might come to market on such channels of trade during the year. But the tonnage, domestic and foreign, that departed from the whole United States in 1826, was 1,052,429. Supposing that one-tenth of this departed from Boston, one slight railroad, sufficient for a man to move one ton weight upon it at a time in a car, would convey all its merchandize; and two such railroads would convey to New-York all the goods it would export.

If, however, such railroads would be altogether insufficient for large cities, they might be channels of communication between villages in the country, and from small districts of country to great roads.

Where there is business enough to employ sufficiently a very large capital, invested in heavy railroads, and powerful steam carriage, steam will be found a cheaper power than human strength; but there is a vastly greater amount of capital required for such purposes, and yet the conveyance cannot be indefinitely extended: it must be limited by the population and resources of the country.

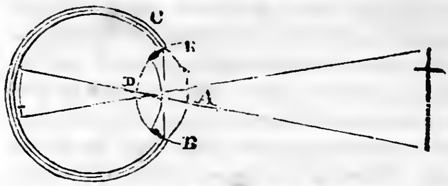
The cost of a road that shall every where, over vallies and rivers, be strong enough to sustain the weight and movements of a car of ten tons weight, must be about ten times as great as the cost of a road that shall have to sustain at one point but a ton weight.

We should think it absurd to have a huge, heavy pipe, of a foot diameter, to convey water in occasional gushes, when an inch pipe would convey all the water we should desire or could procure, and just as we should need it too. But if some railroads of gigantic dimensions are to traverse the country, let the trial be

made, by those who have resources to make the experiment, whether narrow railroads for the application of human strength might not be made that would greatly facilitate communication between different sections of the interior; and that would be to the great railroads, what the little rills and streams are to the Ohio, the Mississippi, and Missouri. Every judicious speculator will wish that his plans may, if possible, be fairly tested by experiment; and tested in this way by those who are able to do it without hazarding losses which they cannot safely bear. The plan here suggested is one that can easily be brought to the test of experiment. If, on a railroad, for half a mile in extent, a man can move a load of a ton weight at the average speed of but two miles, then it will be established that such railroads will be economical, and most convenient lines of conveyance over all the country, and especially to those great railroads where steam machinery works cheaper than men's limbs can do.

On the Human Eye—Description of its Structure, &c. [From Dr. Arnott's Elements of Physics.]

The *human eye* is a globular chamber of the size of a large walnut, formed externally by a very tough membrane called, from its hardness, the *sclerotic coat*, in the front of which there is one round opening or window, named, because of its horny texture, the *cornea*. The chamber is lined with a finer membrane or web—the *choroid*, which, to ensure the internal darkness of the place, is covered with a black paint, the *pigmentum nigrum*. This lining at the edge of the round window is bordered by a folded drapery—the *ciliary processes*, hidden from without by being behind the curious contractile window curtain, the *iris*, through the central opening of which, or *pupil*, the light enters. Immediately behind the pupil is suspended by attachments among the ciliary processes, the *crystalline lens*, a double convex most transparent body of considerable hardness, which so influences the light passing through it from external objects as to form most perfect images of these objects in the way already described, on the back wall of the eye, over which the optic nerve, then called the *retina*, is spread as a second lining. The eye is maintained in its globular condition by a watery liquid, which distends its external coverings, and which in the compartment before the lens, or *the anterior chamber of the eye*, being perfectly limpid, is called the *aqueous humor*, and in the remainder or larger *posterior chamber*, being inclosed in a transparent spongy structure, so as to acquire somewhat of the appearance of melted glass, is called the *vitreous humor*.



The annexed figure represents an eye of the common dimensions, supposed to be cut through the middle downwards. C is the outer or *sclerotic coat*, known popularly, where most exposed in front, as the *white of the eye*. A is the transparent cornea joined to the edge of the round opening of the sclerotic: it is more bulging than the sclerotic, or forms a portion of a smaller sphere than the general eye-ball, so that while it may be truly called a *bow window*, it, or rather the convex surface of its contained water, is also a powerful lens for acting on the pencils of entering light. At B, and similarly all around the edge of the cornea, is attached the window curtain or *iris*, shown here edgeways, immersed in the aqueous humor, and hanging inwards from above and below towards its central opening or *pupil*, through which the rays of light are passing to the lens. The iris has in its structure two sets of fibres, the circular and the radiating, which cross and act in opposition to each other. When the circular fibres contract, the pupil is lessened; when the radiating contract, it is enlarged: and the changes happen according to the intensity of light and the state of sensibility of the retina,—as may at any time be proved by closing the eye-lids for a moment to make the pupil dilate, and then opening them towards a strong light, to make it contract. Behind the pupil is seen the *lens* D with its circumference attached to the *ciliary processes* E: it is more convex behind than before. The disease of the eye, called *cataract*, (from a Greek word implying *obstruction*,) is the circumstance of the lens becoming opaque, and the cure is to extract the lens entirely, or to depress it to the bottom of the eye, and then to

substitute for it externally a powerful artificial lens or spectacle-glass. The three lines, forming here the boundary of the eye, stand for its three coats, as they have been called, the strong *sclerotic*, and the double lining of the *choroid* and *retina*. The figure of a cross is represented upon the retina as formed by the light entering from the cross without, which cross has to appear here small and near, although supposed to be large and distant. The image of the cross is inverted, as explained for the camera obscura: but we shall learn below that the perception of an object may be equally distinct in whatever position the image be on the retina. It has been explained above, that a lens can form a perfect image of considerable extent only on a concave surface, and the retina is such a surface. The present diagram farther explains what is meant by the *anterior* and *posterior chambers* of the eye, viz. the compartments which are before and behind the crystalline lens D.

The nature of the eye as a camera obscura is beautifully exhibited by taking the eye of a recently killed bullock, and after carefully cutting away or thinning the outer coat of it behind, by going with it to a dark place and directing the pupil towards any brightly illuminated objects; then, through the semi-transparent retina left at the back of the eye, may be seen a minute but perfect picture of all such objects—a picture, therefore, formed on the back of the little apartment or camera obscura, by the agency of the convex cornea and lens in front.

Understanding from all this, that when a man is engaged in what is called looking at an object, his mind is in truth only taking cognizance of the picture or impression made on his retina, it excites admiration in us to think of the exquisite delicacy of texture and of sensibility which the retina must possess, that there may be the perfect perception which really occurs of even the separate parts of the minute images there formed. A whole printed sheet of newspaper, for instance, may be represented on the retina on less surface than that of a finger nail, and yet, not only shall every word and letter be separately perceivable, but even any imperfection of a single letter. Or, more wonderful still, when at night an eye is turned up to the blue vault of heaven, there is pourtrayed on the little concave of the retina the boundless concave of the sky, with every object in its just proportions. There a moon in beautiful miniature may be sailing among her white edged clouds, and surrounded by a thousand twinkling stars, so that to an animalcule supposed to be within and near the pupil, the retina might appear another starry firmament with all its glory. If the images in the human eye be thus minute, what must they be in the little eye of a canary bird, or of another animal smaller still! How wonderful are the works of Nature!

NATURAL WONDERS.—It is very surprising that two of the greatest natural curiosities in the world are within the United States, and yet scarcely known to the best informed of geographers and naturalists. The one is a beautiful water-fall in Franklin county, Georgia; the other a stupendous precipice in Pendleton district, South Carolina: they are both faintly mentioned in the late edition of Morse's Geography; but not as they merit. The Tuccoa falls are much higher than the falls of Niagara. The column of water is propelled beautifully over a perpendicular rock, and when the stream is full it passes down without being broken. All the prismatic effect seen at Niagara illustrates the spray of Tuccoa. The Table Mountain in Pendleton district, South Carolina, is an awful precipice of 900 feet. Many persons reside within five, seven, or ten miles of this grand spectacle, who have never had curiosity or taste enough to visit it. It is now, however, occasionally visited by curious travellers, and sometimes men of science. Very few persons who have once cast a glimpse in the almost boundless abyss can again exercise sufficient fortitude to approach the margin of the chasm. Almost every one, in looking over, involuntarily falls to the ground, senseless, nerveless, and helpless; and would inevitably be precipitated and dashed to atoms, were it not for measures of caution and security, that have always been deemed indispensable to a safe indulgence of the curiosity of the visitor or spectator. Every one, on proceeding to the spot whence it is usual to gaze over the wonderful deep, has, in his imagination, a limitation, graduated by a reference to instances with which his eye has been familiar. But in a moment, eternity, as it were, is presented to his astonished senses; and he is instantly over-

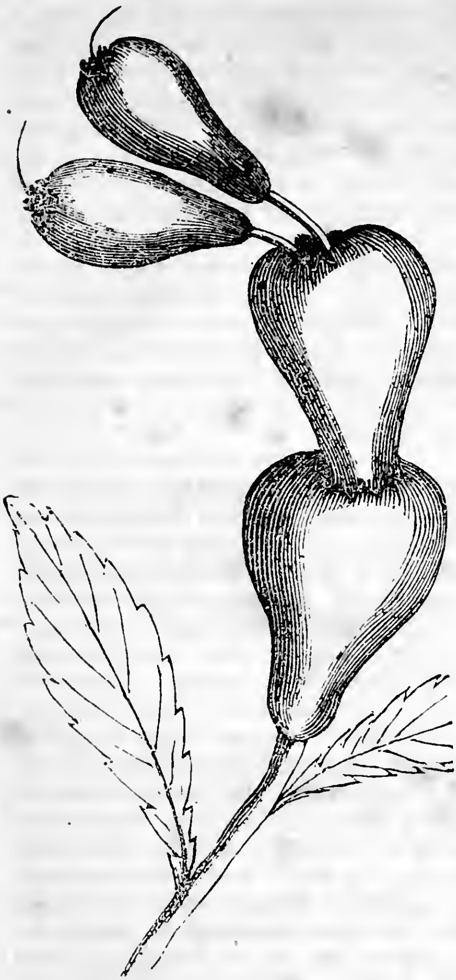
whelmed. His system is no longer subject to his volition or his reason, and he falls like a mass of pure water. He then revives, and in a wild delirium surveys a scene which, for a while, he is unable to define by description or imitation.

How strange is it that the Tuccoa Falls and Table Mountain are not more familiar to Americans! Either of them would distinguish an empire or state in Europe.

FORMATION OF CHARACTER.—A taste for useful reading is an effectual preservative from vice. Next to the fear of God implanted in the heart, nothing is a better safeguard than the love of good books. They are the hand-maids of virtue and religion. They quicken our sense of duty, unfold our responsibilities, strengthen our principles, confirm our habits, inspire in us the love of what is right and useful, and teach us to look with disgust upon what is low, and grovelling, and vicious. It is with good books as it is with prayer; the use of them will either make us leave off sinning, or leave off reading them. No vicious man has a fondness for reading. And no man who has a fondness for this exercise is in much danger of becoming vicious. He is secured from a thousand temptations to which he would otherwise be exposed. He has no inducement to squander away his time in vain amusements, in the haunts of dissipation, or in the corrupting intercourse of bad company. He has a higher and nobler source of enjoyment to which he can have access. *He can be happy alone;* and is indeed never less alone, than when alone. Then he enjoys the sweetest, the purest, the most improving society, the society of the wise, the great, and the good; and while he holds delightful converse with these, his companions and friends, he grows into a likeness to them, and learns to look down, as from an eminence of purity and light, upon the low-born pleasures of the dissipated and profligate.

The high value of mental cultivation is another weighty motive for giving attendance to reading. What is it that mainly distinguishes a man from a brute? Knowledge. What makes the vast difference there is between savage and civilized nations? Knowledge. What forms the principal difference between men as they appear in the same society? Knowledge. What raised Franklin from the humble station of a printer's boy to the first honors of his country? Knowledge. What took Sherman from his shoemaker's bench, gave him a seat in Congress, and there made his voice to be heard among the wisest and best of his compeers? Knowledge. What raised Simpson from the weaver's loom, to a place among the first of mathematicians; and Herschel, from being a poor fifer's boy in the army, to a station among the first of astronomers? Knowledge. Knowledge is power. It is the philosopher's stone—the true alchemy that turns every thing it touches into gold. It is the sceptre that gives us our dominion over nature: the key that unlocks the store of creation, and opens to us the treasures of the universe.

SPEAKING HEADS.—Next to the eye, the ear is the most fertile source of our illusions, and the ancient magicians seem to have been very successful in turning to their purposes the doctrines of sound. The principal pieces of acoustic mechanism used by the ancients were *speaking* or *singing heads*, which were constructed for the purpose of representing the gods, or of uttering oracular responses. Among these, the speaking head of Orpheus, which uttered its responses at Lesbos, is one of the most famous. It was celebrated, not only throughout Greece, but even Persia, and it had the credit of predicting, in the equivocal language of the heathen oracles, the bloody death which terminated the expedition of Cyrus the Great into Scythia. Oden, the mighty magician of the North, who imported into Scandinavia the magical arts of the East, possessed a speaking head, said to be of the sage Minos, which he had encased in gold, and which uttered responses that had all the authority of divine revelation. The celebrated Gerbert, who filled the Papal Chair, A. D. 1000, under the name of Sylvester II, constructed a speaking head of brass. Albertus Magnus is said to have executed a head in the thirteenth century, which not only moved but spoke. It was made of earthen ware, and Thomas Aquinas is said to have been so terrified when he saw it, that he broke it in pieces, upon which the mechanist exclaimed, "these, Gods! the labor of thirty years."—Dr. Brewster supposes, that the sound was conveyed to these machines by pipes from a person in another apartment to the mouth of the figure.—[Sir D. Brewster's Letters on Natural Magic.]



An Extraordinary Jargonelle Pear. By Mr. M. Saul. [From the New-York Farmer and American Gardener's Magazine.]

Sir,—The pear, of which the following is a drawing, was grown in this town this season. The one at the stem was first formed; it then sent out a blossom, which produced the second; this produced two blossom buds, from which were grown the two smaller ones. I have an account of a similar production of a pear, grown in another place. There were six well formed pears.

Lancaster, England, October, 1832.

Chemical Amusements.—*Sympathetic Ink.* —Write with a diluted solution of muriate of copper, and the writing will be invisible when cold; but when held to the fire it will appear of a yellow color.

2. Write with a diluted solution of muriate or nitrate of cobalt, and the writing will be invisible; but, upon being held to the fire, it will appear perfectly distinct, and of a blue color; if the cobalt should be adulterated with iron, the writing will appear of a green color; when taken from the fire, the writing will again disappear. If a landscape be drawn and all finished with common colors, except the leaves of the trees, the grass and the sky, and the latter be finished with this sympathetic ink, and the two former with the adulterated solution just mentioned, the drawing will seem to be unfinished, and have a wintry appearance; but upon being held to the fire, the grass and the trees will become green, the sky blue, and the whole assume a rich and beautiful appearance.

This landscape will, at any time, exhibit the same appearance.—[Delaware Free Press.]

On the Probable Application of Steam Power to Various Purposes.—It is not improbable, that in nothing will greater changes be effected before the close of the year which has just commenced, than in the purposes to which this tremendous agent will be applied. Every day brings to light some new form in which its irresistible energies may be employed. Ten years ago, the idea of substituting a steam engine for a horse, as propelling power upon a turnpike, would have been thought chimerical; and the projector who should have talked of travelling from New-York to Philadelphia and back again between sunrise and sunset, would have found his schemes listened to with most ominous shakes of the head and shrugs of the shoulders. Yet these things are done daily before our eyes, and nobody seems astonished.

Most of the London presses are worked by steam; logs and marble are sawed, and chickens are hatched by steam; potatoes are boiled, money is coined, whiskey distilled, water is pumped, bullets are driven, gun-barrels bored, watch cases turned, foul clothes washed, tortoise shell combs mended, anchors hammered, ships' cables twisted, linen is bleached, sugar refined, jellies and soups are made, and houses warmed, by steam; in short, there is scarcely an object of human necessity, comfort or luxury, in the production of which some use is

not made of this universal and most accommodating of all agents.

No man can set bounds to its utility and the modes of its application. We shall not be surprised to find it, before the year is out, employed to extinguish fires, to blast rocks, or in excavating the earth for canals; some of us may live to see men enabled, by its assistance, to traverse the air, or explore the depths of the ocean; and who knows even but that its energies may in some future age, when man's knowledge and ingenuity shall have reached their highest state of perfection, be successfully directed to the discovery of the philosopher's stone, the north-west passage, and the long-sought for "perpetual motion?"

To prepare Starch from Potatoes.—Grind a quantity of potatoes into a pulp by rubbing them on a plate of tin in which a number of holes have been made, then put them into a hair sieve, and pour cold water over them as long as a milky liquid passes through. This liquid is to be received into a basin, and when a whitish powder has settled at the bottom, the liquid is to be poured off it, and the powder repeatedly washed with spring water, until it becomes perfectly white. When the last liquor has been poured off, the basin is to be placed in a warm place till the starch be perfectly dry.

Observation.—Twenty pounds of good potatoes, treated in this way, generally yield about four pounds of starch.

Mode of Thrashing in Germany.—A laborer's hire is his meat and two goschens, about two pence half-penny a day, unless he happens to be employed in thrashing, in which case he usually makes a contract for a sixteenth measure of the whole quantity of grain he thrashes out. As the entire village resounds from end to end with this operation, I shall state a few particulars respecting it which are likely to escape a more fugitive traveller, or one less curious in "re-rustica." Thrashing here is executed with a skill unknown to a less musical people. To be an expert thrasher it appears to me as requisite to have had a thrashing master, as a master for any other given art or accomplishment. They thrash with a perfect regard to time, in all the alternations of triple and common measure, making the transition from one to the other with the greatest exactness. There are some times no fewer than seven or eight flails in concert; when it is a simple quarter, and one of the performers happens to drop out, which is frequently the case, the transition is immediately, and without the least interruption, into triplets. Occasionally the effect is graced by some very delicate gradations of forte and piano, raliemando, crescendo, morcendo, accellerando—and the whole executed with as much precision as if a note book lay before each performer. When the piano is to be particularly delicate, the tips of the flails are used, which affords an opportunity of combining grace with dexterity; it is then the merest scarcely audible tap, and costs the least possible effort. Then comes the crescendo, swelling into a tremendous barn-echoing staccato—downright thrashing in fact; and what I particularly wish to enforce upon the farmer, the flail during the whole movement is never raised higher than the head, which I could not help especially taking a note of for the good of our practical agriculturists, when I recollect how much unnecessary brawn is expended on our thrashing floor to no purpose. Thus we see his genius for music never forsakes the German in any situation or occupation of life; it follows him into his commonest employments; and no doubt is their advantage, on the principle of "studio fallente laborem," in making it in all similar exertions an arithmetical operation. What is the story of Amphion building his Thebes, but an allegorical illustration of the same benefit of lightening labor by music? The German thrasher has the advantage of the Theban architect, for he turns the labor itself into a kind of music, though somewhat monotonous to be sure.—[Sir A. B. Falkner's Visit to Germany.]

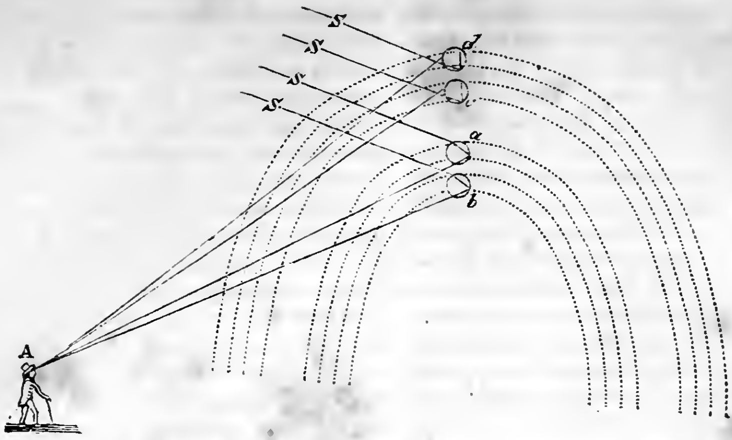
Early Frugality.—In early childhood you lay the foundation of poverty or riches, in the habits you give your children. Teach them to save every thing—not for their *own* use, for that would make them selfish—but for *some* use. Teach them to *share* every thing with their playmates; but never allow them to destroy anything. I once visited a family where the most exact economy was observed; yet nothing was mean or uncomfortable. It is the character of true economy to be as comfortable with a little, as others can be with much. In this family, when the father brought home a pack-

age, the older children would, of their own accord, put away the paper and twine neatly, instead of throwing them in the fire, or tearing them to pieces. If the little ones wanted a piece of twine to spin a top, there it was in readiness; and when they threw it upon the floor, the older children had no need to be told to put it again in its place.—[Frugal Housewife.]

Spontaneous Combustion.—That animal bodies are liable to internal combustion is a fact which was well known to the ancients. Many cases which have been adduced as examples of spontaneous combustion are merely cases of individuals who were highly susceptible of strong electrical excitation. In one of these cases, however, Peter Bovisteau asserts that the sparks of fire thus produced reduced to ashes the hair of a young man; and John de Viana informs us, that the wife of Doctor Frielas, physician to the Cardinal de Royas, Archbishop of Toledo, emitted by perspiration an inflammable matter of such a nature that, when the ribbon she wore over her shift was taken from her, and exposed to the cold air, it instantly took fire and shot forth like grains of gunpowder. Peter Borelli has recorded a fact of the very same kind respecting a peasant whose linen took fire, whether it was laid up in a box when wet or hanging in the open air. The same author speaks of a woman who, when at the point of death, vomited flames, and Thomas Bartholia mentions this phenomenon, as having often happened to persons who were *great drinkers of wine and brandy*. Ezekiel de Castro mentions the singular case of Alexandrinus Megeteus, a physician, from one of whose vertebrals there issued a fire which scorched the eyes of the beholders, and Kantius relates, that during the wars of Godfrey of Bologne, certain people of the territory of Nivers were burning with invisible fire, and that some of them cut off a foot or a hand where the burning began in order to arrest the calamity. —[D. Brewster's Letters on Natural Magic.]

Rowland's Forcing Pump.—According to public notice, a trial was made on Wednesday of the power of this machine to supply the engines in case of fire, and the extent to which it would propel the water through the hose. The hose was laid in Chapel street, a thousand feet in length, extending from the mill in Union st. to Forbes' buildings, corner of Church and Chapel streets. At the signal given, the pump was set in motion—in two minutes the water reached the extent of the hose, and in four minutes the engine began to play on the buildings, throwing the water upon the roof of Forbes' four stories—the pump furnishing much more than the engine could deliver, probably enough for two or three. The immense importance of this machine, in case of fire, is now so decidedly established, that we think our city authorities can no longer delay in securing its benefits. For supplying water, it is worth all the other means in the city combined; and we trust that the niggardly policy of saving two or three hundred dollars and leaving hundreds of thousands in jeopardy will no longer be pursued, by the guardians of the public weal. The advantages of the pump can be extended with equal facility in every direction, and we believe similar improvements may be made in other parts of the city, by which all may derive equal benefit and protection.—[New-Haven Herald.]

Self-acting Fire Alarm.—An invention, christened with this name, was brought to this office last week for short exhibition. The purpose of the machine is to give timely alarm when fire occurs in any part of the house in which it is placed. Only one is necessary to a house of the largest size, and if rightly put up, cannot fail to give seasonable warning of the approaching danger. It is intended to be located in the sleeping-room of the "man of the house," and if desired, will also answer the purpose of a fashionable and convenient looking-glass. Its communication with the other apartments is accomplished by means of small cords, which pass entirely round each room in the upper corners of the walls, and are supported by small pullies. Whenever a room takes fire the string burns off, and this puts the "Alarm" in operation, and unless the tenant is an uncommon sleepy fellow, his house may be saved with very little trouble. A further description at this time, is perhaps unnecessary, as the advertisements and handbills already before the public may be referred to. As far as our opinion goes, we believe the invention above mentioned to be a simple and safe agent for the security of our fellow citizens against the continual losses of life and property to which they are liable.—[Brooklyn Advertiser, L. I.]



Of the Rainbow.—The phenomena of the rainbow consists, as every person knows, of two bows, or arches, stretching across the sky, and tinged with all the colors of the prismatic spectrum. The internal or principal rainbow, which is often seen without the other, has the *violet* rays *innermost*, and the *red* rays *outermost.* The external, or secondary rainbow, which is much fainter than the other, has the violet color outermost, and the red color innermost. Sometimes supernumery bows are seen accompanying the principal bows.

As the rainbow is never seen unless when the sun shines, and when rain is falling, it has been universally ascribed to the decomposition of white light by the refraction of the drops of rain, and their reflection within the drops. The production of rainbows by the spray of waterfalls, or by drops of water scattered by a brush or syringe, is an experimental proof of their origin.

Let an observer be placed with his back to the sun, and his eye directed through a shower of rain to the part of the sky opposite to the sun. As the drops of rain are spherical particles of water, they will reflect and refract the sun's rays, according to the usual laws of refraction and reflection. Thus in the preceding figure, where *s s s s* represent the sun's rays, and A the place of a spectator, in the centre of the two bows (the planes of which are supposed to be perpendicular to his view), the drops *a* and *b* produce part of the *inner* bow by two refractions and one reflection ; and the drops *c* and *d* part of the exterior bow, by two refractions and one reflection.

This holds good at whatever height the sun may chance to be in a shower of rain; if high, the rainbow must be low; if the sun be low, the rainbow is high: and if a shower happen in a vale when a spectator is on a mountain, he often sees the bow completed to a circle below him. So in the spray of the sea, or a cascade, a circular rainbow is often seen; and it is but the interposition of the earth that prevents a circular spectrum from being seen at all times, the eye being the vertex of a cone, whose base (the bow) is in part cut off by the earth.

It is only necessary, for the formation of a rainbow, that the sun should shine on a dense cloud, or a shower of rain, in a proper situation, or even on a number of minute drops of water, scattered by a brush or by a syringe, so that the light may reach the eye after having undergone a certain angular deviation, by means of various refractions and reflections, as already stated. The light which is reflected by the external surface of a sphere, is scattered almost equally in all directions, setting aside the difference arising from the greater efficacy of oblique reflection : but when it first enters the drop, and is there reflected by its posterior surface, its deviation never exceeds a certain angle, which depends on the degree of refrangibility, and is, therefore, different from light of different colors : and the density of the light being the greatest at the angle of greatest deviation, the appearance of a luminous arch is produced by the rays of each color at its appropriate distance. The rays which never enter the drops produce no other effect than to cause a brightness, or haziness, round the sun where the reflection is the most

oblique: those which are once reflected within the drop exhibit the common internal or primary rainbow, at the distance of about 41 degrees from the point opposite to the sun: those which are twice reflected, the external or secondary rainbow, of 52°; and if the effect of the light, three times reflected, were sufficiently powerful, it would appear at the distance of about 42 degrees from the sun. The colors of both rainbows encroach considerably on each other; for each point of the sun may be considered as affording a distinct arch of each color, and the whole disc as producing an arch about half a degree in breadth, for each kind of light; so that the arrangement nearly resembles that of the common mixed spectrum.

A *lunar rainbow* is much more rarely seen than a solar one; but its colors differ little, except in intensity, from those of the common rainbow.

The appearance of a rainbow may be produced at any time, when the sun shines, as follows: opposite to a window, into which the sun shines, suspend a glass globe, filled with clear water, in such a manner as to be able to raise it or lower it at pleasure, in order that the sun's rays may strike upon it. Raise the globe gradually, and when it gets to the altitude of forty degrees, a person standing in a proper situation will perceive a purple color in the glass, and upon raising it higher the other prismatic colors, blue, green, yellow, orange, and red, will successively appear. After this the colors will disappear, till the globe be raised to about fifty degrees, when they will again be seen, but in an inverted order; the red appearing first, and the blue, or violet, last. Upon raising the globe to about 54°, the colors will totally vanish.

In the highest northern latitudes, where the air is commonly loaded with frozen particles, the sun and moon usually appear surrounded by *halos*, or colored circles, at the distances of about 22 and 46 degrees from their centres. Several new forms of *halos* and *paraselenæ*, or mock-moons, have been described by Captain Ross and Captain Parry. And Captain Scoresby, in his account of the Arctic Regions, has delineated an immense number of particles of snow, which assume the most beautiful and varied crystallizations, all depending more or less on six-sided combinations of minute particles of ice.

When particles of such forms are floating or descending in the air, there can be no difficulty in deriving from them those various and intricate forms which are occasionally met with among this class of phenomena.

Halos are frequently observed in other climates, as well as in the northern regions of the globe, especially in the colder months, and in the light clouds which float in the highest regions of the air. The halos are usually attended by a horizontal white circle, with brighter spots, or parhelia, near their intersections with this circle, and with portions of inverted arches of various curvatures; the horizontal circle has also sometimes *anthelia*, or bright spots nearly opposite to the sun. These phenomena have usually been attributed to the effect of spherical particles of hail, each having a central opaque portion of a certain magnitude, mixed with oblong particles, of a determinate form, and floating with a certain constant obliquity to the horizon. But all these arbitrary suppositions, which were imagined by Huygens, are in themselves extremely complicated and improbable. A much simpler, and more natural, as well as more accurate explanation, which was suggested at an earlier period by Mariotte, had long been wholly forgotten, till the same idea occurred to Dr. Young. The explanation given by the last mentioned philosophers is, that water has a tendency to congeal or crystallize in the form of a prism, and that the rays of light passing through these prisms, (which are disposed in various positions,) by their own weight, are so refracted as to produce the different appearances which halos and parhelia have been observed to assume.

The colors which these phenomena exhibit are nearly the same as the rainbow, but less distinct; the red being nearest to the luminary, and the whole halo being very ill-defined on the exterior side. Sometimes the figures of halos and parhelia are so complicated, as to defy all attempts to account for the formation of their different parts; but if the various forms and appearances which the flakes of snow assume be considered, there will be no reason to think them inadequate to the production of *all* these appearances.

To take out Grease Spots from a carpet, or any other woollen cloth, dissolve a piece of pearl-ash of the size of a pea in a half a tea-cup of warm water; or a piece twice the size in a

full tea-cup. Pour some of the solution on the grease spot, and continue to rub it hard with a clean brush or woollen cloth until it is nearly dry, and your carpet or garment will be as clean as ever. I have tried it repeatedly and found it effectual.

Manufactories, Botanic Garden, of Liverpool, and Railway connecting Liverpool with Manchester. By B. P. [From the New-York Farmer.]

Liverpool, though situated in the most extensive manufacturing *county* in the kingdom, is not in itself, properly speaking, a manufacturing town, still many branches of manufactured articles are on an extensive scale, viz. Potteries, breweries, foundries, &c. The making of files, watches, watch movements and tools used by watch makers, is carried on to a greater extent probably in Liverpool and its environs than in any part of the kingdom. There are also extensive manufactories of chain cables, anchors, steam engines, &c. There is also an establishment for glass staining in landscape, figures, or ornaments; the art is brought to a high degree of perfection, and has a most beautiful effect in church windows.

The *Botanic Garden* is pleasantly situated in the environs, and is enclosed by a stone wall with two ornamental lodges at the entrance, and a very large conservatory. It appears to be under the eye of those who have not only the taste but the means of gratifying it, as every thing appears to be of the most permanent construction. The taste for botanical studies, and the establishment of such a fine garden as that at Liverpool, is worthy of imitation by every large city. To describe the contents would be tedious; suffice it to say, the garden appeared to contain every species of useful and ornamental fruit or flowers. Strangers are admitted by taking a note from any of the directors to the superintendant.

Liverpool abounds in fine public buildings, charitable and literary institutions, several fine monuments, &c. but I pass over them to give you a short description of the railway which connects it with Manchester, and which is probably one of the most stupendous undertakings of the age. The work was commenced in June, 1826. The entrance commences in Wapping, near the Docks, and passes under the town in a gentle curve to the right or south-east, till it reaches the bottom of the inclined plane, which is a perfectly straight line 1,980 yards in length, with a uniform rise of $\frac{3}{4}$ of an inch to a yard. The tunnel under the town is 22 feet wide and 16 feet high, the sides being perpendicular for 5 feet in height, surrounded by a semi-circular arch of 11 feet radius—the total length is 2,250 yards. It is whitewashed throughout, and illuminated with gas. At the upper or eastern end of the tunnel, the traveller emerges into a spacious and noble area 40 feet below the surface of the ground, cut out of the solid rock, and surmounted on every side by walls and battlements. A massive Moorish archway stretches across the road, close by the engine houses, which are employed in the generation of steam power to draw goods from the mouth of the tunnel in Wapping, and the carriages with passengers through the tunnel on their return from Manchester. Crossing the street the road descends for five miles and a half at the rate of 4 feet in the mile. At a little distance it is carried through a deep marl cutting, under several stone arches, beyond which is the great rock excavation through Olive Mount; the depth is 70 feet.

A night journey through this artificial ravine must be highly interesting and sublime; a few minutes suffice to carry the traveller to the magnificent embankment between Broad, Green, and Roby, which in fine weather presents a portion of the most interesting and varied landscape which meets the eye during the journey to Manchester. On the right a superb line of trees partially bound the view for some distance, when Childwald Vale bursts upon the sight, with its gently rising green slope; on the side of which the church peeps through the trees, and forms an object of uncommon interest; its dark red color firmly contrasting with the masses of fine green foliage by which it is surrounded.

> "——— The land was beautiful:
> Fair rose the spires, and gay the buildings were,
> And rich the plains."

The Abbey of Childwald and its grounds display themselves still farther in the rear; Roby Hall and domains, with the richly wooded townships of Little Woolton and Halewood, the lofty back ground of Runcorn in the distance; on the left, Summer Hill and its beautiful grounds, a richly cultivated country, broken up into picturesque variety by the nature of the ground and the varied bodies of foliage and forest scenery which mark the sight of Knows-

ley Hall, a glimpse of which may be caught *en passant*. The venerable tower of Huyton Church rising above the trees seems to dispute the way in front, whilst the spire of Prescot Church forms a conspicuous object a little more to the left. On the summit of the hill, eight miles from Liverpool, begins the inclined plane at Whiston, which rises at the rate of $\frac{3}{8}$ of an inch in a yard, and is a mile and a half long. About half a mile from the top of this plane the turnpike road from Liverpool to Manchester crosses the line of the railway, by a substantial stone bridge of very curious mechanical construction. We then soon come to what is called Parr Moss, the depth of which is about 20 feet; and here the material forming the railway, as it was deposited, sank to the bottom, and now forms an embankment in reality 25 feet high, though only 4 or 3 feet appear above the surface of the Moss.

The borders of this waste are in a state of increasing cultivation, and carrying the railway across this Moss will hasten the enclosure of the whole area. Leaving Parr Moss the great valley of the Sankey speedily breaks upon the sight, with its canal at the bottom. Over this valley the railway is carried along a magnificent viaduct of nine arches, each 50 feet span, the height from the top of the parapets to the water in the canal being 70 feet, and the width of the railway between the parapets 25 feet; from this spot a splendid prospect of the country is obtained, with the meanderings of the canal through a richly wooded country, where the vessels which navigate the Mersey may frequently be seen moving along the canal, impelled by the wind apparently through fields, with all their canvass set, amidst trees and rising grounds, forming a view at once unique and picturesque—whilst the most distant part of the landscape, Newton race-course, and a luxuriant back ground, on the left, with Barton wood, Winwick spire, and all the varieties of a rich agricultural country, embracing the lonely vale through which the canal runs towards the Mersey, on the right, presents a scene on which the eye delights to rest. A distant view of Warrington with the upper reach of the Mersey and Helsby Hills in the distance, form prominent objects. On the other side of Newton is the great Kenyon excavation, near the end of this cutting the Kenyon and Leigh junction railway joins the Liverpool and Manchester line, pointing to the two towns respectively; this railway, at the same time, by means of the Bolton and Leigh line, perfects the communication between Bolton, Manchester and Liverpool. Beyond Bury-lane and the small river Gless or Glazebrook, lie the borders of the far-famed Chat Moss.

This barren waste comprises an area of about 12 miles square, varying in depth from 10 to 35 feet, the whole Moss being of so spongy a nature that cattle cannot walk over it, but it is now under a process of draining and cultivation: over this morass the road is carried. There is little of interest in the scenery except on the left, Worsley Hall and grounds, Tidsley Church, with the back ground of Billinge Hills. Having accomplished the passage of the moss and traversed the Barton embankment of about one mile, the railway crosses the Worsley Canal, and here the traveller first sees indications of a manufacturing district. Cotton factories begin to appear, and as the road approaches Manchester the scene acquires additional interest from the presence of several country seats. The immediate approach to Manchester is through Salford, over the river Irwell; a very handsome stone bridge and a series of splendid arches finally conduct the railway to the Company's station. The bridges alone, exclusive of the culverts and foot stages, are sixty-three in number, which have cost the Company £99,065 11*s*. 9*d*. As an instance of what may be accomplished by the railway, the following is annexed, which took place in February 1831.

The Locomotive Engine, called the Sampson, started from the tunnel mouth with thirty loaded waggons, occupying a line of 120 yards long. The weight of the whole was as follows:

Gross weight, 151 tons.

	Tons.	Cwt.	Qr.
Net weight of Oats and Sacks	82	10	0
Do. of Merchandize	24	15	0
Do. of 15 persons	1	00	0
	108	05	0

She performed the journey to Manchester, a distance of twenty-nine miles and three quarters, in two hours and thirty-four minutes, including a stop of thirteen minutes for taking in water—her greatest speed was twenty miles per hour, and the average about twelve miles per hour. Although the railway cost £820,000, equal to $3,630,800, still the profits are such

that the shares bear a very high premium. The arrival of an American in a place like Manchester is generally attended with unpleasant sensations; the coach generally leaves passengers at the "Bridgewater Arms," an old inn, and more worthy of a preference from its antiquity than its excellence. A little observation will soon learn a traveller that passengers arriving in the coaches do not receive the attention that those who come in a post chaise or private carriage do. Appearances often command respect and attention even in our republican country, and in all countries often take the place of worth.

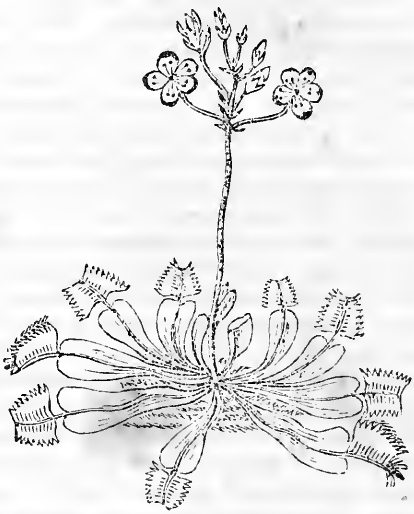
Manchester is larger than Liverpool, and is second only to the metropolis. Many of the dwellings and warehouses are built on narrow and crooked streets, principally of brick, of a very dusky hue, which is much increased by the coal smoke from the numerous manufactories and dwellings, hence they have a dark and gloomy appearance, which is much increased by the very frequent rains which fall in Manchester, and which are attributed to the mountainous regions in the vicinity. Few places are less interesting than Manchester, excepting always her manufactories; and the misery, want and wretchedness of the operatives would almost make one wish that manufactures had never advanced, and ancient modes of the wheel and distaff been confined to private families as formerly. A writer remarks, that of the thousands that throng Manchester, crowded together in narrow streets, where the everlasting din of machinery is heard, you scarcely see a person whose appearance bespeaks comfort. However, we saw some interesting objects, which I will describe in my next.

On the Composition of Organized Structures, Similarity of Charcoal to the Diamond, &c. Selected for the Mechanics' Magazine, from Donovan's Chemistry.

Notwithstanding the perplexing diversity of form which vegetable substances assume, experiments have proved that they are all composed of the same ultimate materials, and these very few in number. We may select any vegetable structure as the representative of all the rest: and, by examining others in the same manner, it will be found that they present the same results. The method by which the component elements are separated is simple; the vegetable is merely exposed to the action of fire: not an open fire, for in this way all its parts would be dissipated or burned away; but in a vessel calculated to retain its principles in such a manner as to permit their being brought under examination. Green wood will be a good instance. Take a common gun barrel, the touch-hole of which is stopped; push a small cylinder of green wood down to the breech, and place that end horizontally in a good coal fire. As the wood is heated, the water, which is the chief ingredient of its juices, distils over, and drops from the open end of tube. In proportion as the water distils, from being insipid, it becomes sour. Shortly after, a gas issues out of the tube, and may be collected by tying a moist bladder, the common air being well pressed out of it, round the mouth of the tube. If, when the gas ceases to issue, the contents of the tube be examined, the piece of wood will be found altered into a black, dry, light, sonorous mass, retaining, however, its texture, though much reduced in size. It is, in short, converted into charcoal, or, in chemical language, carbon; and, if its weight be added to that of the gas, the mere water, and the sour water, the result will be the original weight of the wood without loss; hence these are all the ingredients which composed the wood. As a general summing up, we may recapitulate, that from wood we obtain hydrogen, carburetted hydrogen, bicarburetted hydrogen, carbonic oxide, carbonic acid, ascetic acid, holding tar, ammonia, and charcoal. By multiplying experiments on other vegetable structures, we learn, that all of them, however complicated when made to undergo the ordeal of heat in confined vessels, resolve themselves, like wood, into the four elements, oxygen, hydrogen, carbon, and azote; the latter being in such small quantity as to be barely discoverable. These, again, by combining amongst themselves, produce the compounds above described, but the four ingredients mentioned are what are called the ultimate elements of all vegetable matter, notwithstanding its apparent diversity. A striking proof of the extraordinary differences of appearance which the same body may assume, and also of the intrinsic worthlessness of some of those objects on which society sets the highest value, occurs in the instance of the substance under consideration. Every one knows the enormous price at which diamonds of good quality and

size are estimated. The celebrated regent diamond, which was set in the handle of the late Emperor Napoleon's sword of state, is now valued at £260,000, although only $1\frac{1}{8}$ ounce, and was originally purchased for £20,400 by Thomas Pitt, grandfather of the great Earl of Chatham, while Governor of Madras. Yet this precious ornament is neither more nor less than a piece of charcoal; and, surprising as it may appear to those hitherto unacquainted with the fact, it is well proved by numerous experiments, that between the diamond and charcoal there is almost no difference of composition; the diamond burns in oxygen with brilliant flame, and, like charcoal, forms carbonic acid; like charcoal, it forms steel by combination with iron; and the difference between the two bodies seems to be chiefly in their state of aggregation, the diamond being harder and crystallized; it is also a little purer in composition. The pure portion of charcoal is distinguished among chemists by the name of carbon.

Having acquired some acquaintance with the vast variety of form under which the objects constituting the vegetable world appear, and the simplicity of their composition, the next subject of contemplation is the animated part of the creation,—the most interesting and stupendous of all. How much more admirable and surprising must the structure of a living animal appear, when it is known that it is composed of but a few elements, such as have been formerly described: little more than the meanest vegetable, and fewer than many minerals. The materials of which animals are composed being nearly the same, as those which compose plants, the difference is in their relative quantity, and in the mode of combination. The combustible substance, phosphorus, has been detected, in small quantity, in some vegetables, as in the onion; but it exists in large quantities in the bones of animals: not in the state of phosphorus, as commonly seen, but disguised by combination with oxygen in the state of an acid, and this acid combined with lime. The bones of animals, then, consist chiefly of lime and phosphoric acid; at least these ingredients compose their earthly basis, as it is called; but it is impregnated with animal matter that adds greatly to their strength, toughness, and solidity. The other element which exists largely in animal matter is azote: it is also a constituent part of several kinds of vegetable matter; and it is singular, that the same azote, which adds so much to the nutritiousness and flavor of animal food, renders vegetable matter disgusting to the taste, and poisonous. The chief substances, then, which enter largely into animal matter, are oxygen, hydrogen, azote, carbon, phosphorus, and lime. We find some other kinds of matter, as certain acids and metals, but in quantity so small as not to affect the truth of the above statement, that the foregoing six ingredients constitute the great bulk of the animal fabric.



Dionæa Muscipula, Venus' Fly Trap. By Q. Z. [From the New-York Farmer.]

This singular plant is considered one of the most remarkable and curious productions of the vegetable world. It belongs to the class Decandria, order Monogynia of Linnæus. The leaves are radial, lying upon the ground, and consisting of two parts. The lower, which is strictly speaking the leaf, is long, cordate, or heart shape, and is terminated by a single conservative appendage, which forms the upper half. This part consists of two lobes, the margins of which are terminated by ciliate divisions, like the teeth of a rat-trap, to which this singular anomaly is thought to bear a close resemblance, both in its appearance and its manner of operation. These lobes, particularly in dry weather, possess in a remarkable degree the vegetable irritability which has long

been a source of wonder among naturalists, and which is very distinct in the well known sensitive plant and some others. If a fly or any other insect happens to alight upon one of these lobes his fate is almost certain. It closes immediately—the teeth lock themselves together and the poor insect is a prisoner. The greater the struggling the firmer the clasp, and it is either crushed or starved to death; when, the irritation having ceased, the lobe expands itself as before. Irritation with any substance, as a straw, stick, &c. produces the same effect.

It is a native of the swamps and marshes of Georgia and the Carolinas, and bears a profusion of beautiful white flowers in July and August, on stems five or six inches in height.

Newburgh, January, 1833.

Memoir of Mr. Holt.—The following is the brief memoir we had intended to have accompanied the description of his (Holt's) new Hotel, in our January number:

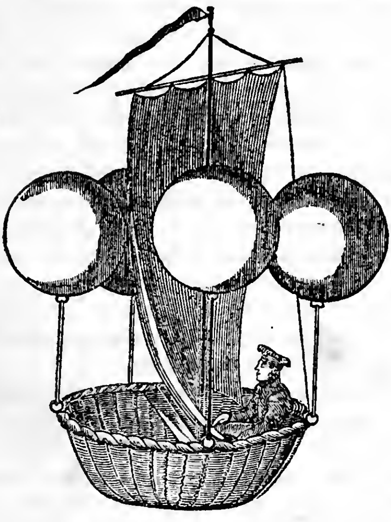
Mr. Holt came to this city from Salem, Mass., about the year 1808, and for some time obtained employment in the business to which he had been brought up, that of a cabinet-maker; he also opened a small store as a victualling-house, in the neighborhood of the Fly-Market, which was managed by Mrs. Holt, and received all that attention which is always bestowed by a clever and affectionate woman to the interests of her husband. He had a numerous young family, and was for a long period in such ill health, that he was eventually induced to leave the bench, and devote all his energies to improving his tavern, in which he succeeded to a very considerable extent.

In this establishment he continued until the year 1814, when Mr. Holt, becoming attached to the commissariat department, (during the time of the location of troops upon the Harlæm lines of the city defences,) opened a boarding-house for the accommodation of the officers, contiguous to their posts. Here he continued until the close of the war dispersed his friends. His old stand at Fly-Market being vacant, he again took possession of it, and continued to give such general satisfaction to those who resorted to his house, that in a short time he was under the necessity of enlarging his premises for their accommodation. Business still increasing, and promising a still further increase, he was induced to take larger premises in Front street, situated between Burling slip and Fulton street. Before these were fit to receive his friends and the public, he found it indispensable to make considerable alterations—much more, indeed, than his own funds could accomplish—but in this respect he found no difficulty, for his persevering industry, integrity, and general habits of business and living, had not escaped the observation of many of his neighbors, and he readily obtained sufficient credit to enable him to open his new establishment. A very short time elapsed, after its completion, before Mr. Holt had to encounter the misfortune of being left destitute in the world. A carpenter's shop in the immediate vicinity of his house caught fire, which soon communicated to his premises, and both were burnt to the ground. Mr. Holt's all was here consumed—absolutely without clothing, he and his family contrived to escape unhurt, but without the means of subsistence even for a single day. With great presence of mind Mrs. Holt had seized the drawer in which was contained the receipts of the previous day; but in the hurry of escaping from the flames, a false step was made, and all was lost, except the trifling sum of three shillings.

To be placed in such a situation with a young and numerous family, is enough to appal the stoutest heart, but in Mr. Holt it seemed only to rouse his energies, and stimulate him to fresh exertions. As might be expected, he had the sympathetic expressions of numerous friends, and a subscription was proposed to be raised in his behalf, but, with a spirit of independence, which cannot be too much admired, he firmly refused to avail himself of assistance by such means.

Although Mr. Holt was involved in debt, and it was well known that he was pennyless, he had no difficulty in obtaining another house in Fulton street; and that consistent character, which he had hitherto maintained, soon enabled him once more to open an establishment equal to the one he had previously occupied: here his old friends flocked around him, and a great accession was made to them, from the peculiar circumstances of his situation being made generally known. From this period Mr. Holt's prosperity has steadily increased. In a very short time he was obliged to enlarge those premises, and eventually to take another house nearly opposite, (part of the latter is shown in

the engraving, on the right hand side of the plate, and where the words "Water street" are inserted.) He continued in active business in those establishments, until January in the present year, when the magnificent building which we have attempted to describe was opened to the public, by whom we have the satisfaction to state he has hitherto been liberally supported. There he now remains an example worthy the imitation of all, and we beg he will accept of our best wishes for his continued prosperity and happiness.



[We copy the following interesting account of Balloons from "MR. PARTINGTON'S BRITISH CYCLOPÆDIA," a work of unparalleled cheapness and of great merit.]

The idea of inventing a machine which should enable us to rise into the air appears to have occupied the human mind even in ancient times, but was never realized till the last century. The first suggestion for a sailing vessel, with any pretensions to the character of science, is due to Francis Lana, a distinguished Jesuit. This occurred in 1670; and the arrangement of the apparatus will be best understood by referring to the preceding figure.

Lana, it will be seen, proposed to support his car by the aid of four balls. These were to be exhausted of air; and the inventor argued that their diminished weight would cause the balls to support themselves and the aeronaut. We notice this apparatus, as similar schemes have been put forth even within our own times; but it must be obvious to any intelligent mind, that the external pressure of the atmosphere would destroy the vessels, even if they could be rendered light enough. Henry Cavendish having discovered, about 1766, the great levity of inflammable air or hydrogen gas, Dr. Black, of Edinburgh, was led to the idea that a thin bladder, filled with this gas, must ascend into the air. Cavallo made the requisite experiments in 1782, and found that a bladder was too heavy, and paper not air tight. Soap bubbles, on the contrary, which he filled with inflammable air, rose to the ceiling of the room, where they burst. In the same year, the brothers Stephen and Joseph Montgolfier constructed a machine which ascended by its own power. In November, 1782, the elder Montgolfier succeeded, at Avignon, in causing a large bag of fine silk, in the shape of a parallelopiped, and containing 40 cubic feet, to mount rapidly upwards to the ceiling of a chamber, and afterwards, in a garden, to the height of 36 feet, by heating it in the inside with burning paper. The two brothers soon afterwards repeated the experiment at Annonay, where the parallelopiped ascended in the open air 70 feet. A larger machine, containing 650 cubic feet, rose with equal success. They now resolved to make the experiment on a large scale, and prepared a machine of linen, lined with paper, which was 117 feet in circumference, weighed 430 pounds, and carried more than 400 pounds of ballast. This they sent up, June 5, 1783, at Annonay. It rose in ten minutes to a height of 6,000 feet, and fell 7,668 feet from the place of ascension. The method used to cause it to ascend was, to kindle a straw fire under the aperture of the machine, in which they threw, from time to time, chopped wood. But, though the desired effect was produced, they had no clear nor correct idea of the cause. They did not attribute the ascension of the vessel to the rarefaction of the air enclosed in it by the operation of the heat, but to a peculiar gas, which they supposed to be developed by the burning of the straw and wood. The error of this opinion was not discovered till a later period. These experiments roused the attention of all the philosophers of Paris. It occurred to some of them, that the same effect might be produced by inflammable air. M. Charles, Professor of Natural Philosophy, filled a ball of lutestring, 12 feet in diameter, and coated with a varnish of gum-elastic, with such gas. It

weighed 25 pounds, rose 3,123 feet in two minutes, disappeared in the clouds, and descended to the earth, after three-quarters of an hour, at the village of Gonesse, about 15 miles from Paris. Thus we see two original kinds of balloons: those filled with heated air, and those filled with inflammable air.

The process of filling balloons on the small scale for this species of aerial navigation, will readily be understood by a reference to the accompanying sketch, in which a simple condenser is employed. The common mode is to generate hydrogen gas in a bottle, by pouring dilute sulphuric acid on granulated zinc, but the hot and moist vapor from the acid speedily destroys the balloon. To prevent this, the experimentor has only to employ a second bottle containing water, and carry a bent-pipe from the first bottle through a cork in the second; it dips beneath the surface, and is condensed, and the pure hydrogen ascends by the second pipe to the balloon.

To continue: Montgolfier had gone to Paris, and found an assistant in Pilatre de Rozier, the superintendent of the Royal Museum. They completed together, in October, 1783, a new machine, 74 feet in height, and 48 in breadth, in which Rozier ventured for the first time to ascend, though only 50 feet. The balloon was from caution fastened by cords, and soon drawn down. Eventually the machine, being suffered to move freely, took an oblique course, and at length sunk down gradually about 100 feet from its starting place. By this the world was convinced that a balloon might, with proper management, carry a man through the air; and the first aerial expedition was determined on.

November 21, 1783, Pilatre de Rozier and the Marquis d'Arlandes ascended from the castle la Muette, in the presence of an innumerable multitude, with a machine containing 6,000 cubic feet. The balloon, after having attained a considerable height, came down, in 25 minutes, about 9,000 yards from la Muette. But the daring aeronauts had been exposed to considerable danger. The balloon was agitated very violently several times; the fire had burnt holes in it; the place on which they stood was injured, and some cords broken. They perceived that it was necessary to descend without delay; but when they were on the surface of the earth, new difficulties presented themselves. The weak coal fire no longer supported the linen balloon, the whole of which fell into the flame. Rozier, who had not yet succeeded in descending, just escaped being burnt. M. Charles, who had joined with M. Robert, soon after informed the public that they would ascend in a balloon filled with inflammable air. To defray the necessary expenses of 10,000 livres, he opened a subscription. The balloon was spherical, 26 feet in diameter, and consisted of silk coated with a varnish of gum-elastic. The car for the aeronauts was attached to several cords, which were fastened to a net, drawn over the upper part of the balloon. A valve was constructed above, which could be opened from the car, by means of cords, and shut by a spring. This served to afford an outlet to the inflammable air, if they wished to descend, or found it necessary to diminish it. The filling lasted several days; and, December 1st, the voyage was commenced from the Tuilleries. The balloon quickly rose to a height of 1800 feet, and disappeared from the eyes of the spectators. The aeronauts diligently observed the barometer, which never stood at less than 26°, threw out gradually the ballast they had taken in to keep the balloon steady, and descended safely at Nesle. But as soon as Robert stepped out, and it was thus lightened of 130 pounds, it rose again with great rapidity about 9,000 feet. It expanded itself with such force, that it must have been torn to pieces, had not Charles, with much presence of mind, opened the valve to accommodate the quantity of gas to the rarity of the surrounding atmosphere. After the lapse of half an hour the balloon sunk down on a plain, about three miles from the place of its second ascent.

Another ascent, which nearly proved disastrous to the aeronauts, may now be noticed.

On the 15th of July, 1784, the Duke of Chartres, the two brothers Roberts, and another person, ascended with an inflammable air balloon from the park of St. Cloud, at 52 minutes past 7 o'clock in the afternoon. This balloon was of an oblong form, measuring $55\frac{1}{2}$ feet in length, and 34 in diameter. It ascended with its greatest extension nearly horizontal; and after remaining in the atmosphere about 45 minutes, it descended at a little distance from whence it had ascended, and at about 30 feet distance from the *Lac de la Garenne*, in the park of *Meudon*. But the incidents that happened in this aerial excursion deserve to be particularly described, as nothing like it had happened before to any of the aerial travellers. This machine contained an interior smaller balloon, filled with common air; by which means, according to a mode hereafter to be mentioned, the machine was to be made to ascend or descend without any loss of inflammable air or ballast. The boat was furnished with a helm and oars, intended to guide it, &c.

On the level of the sea the barometer stood at 30.25 inches, and at the place of departure it stood at 30.12. Three minutes after its ascending, the balloon was lost in the clouds, and the aerial voyagers lost sight of the earth, being involved in a dense vapor. Here an unusual agitation of the air, somewhat like a whirlwind, in a moment turned the machine three times from the right to the left. The violent shocks which they suffered prevented their using any of the means prepared for the direction of the balloon, and they even tore away the silk stuff of which the helm was made. Never, said they, had a more dreadful scene presented itself to any eye, than that in which they were involved. An unbounded ocean of shapeless clouds rolled one upon another beneath, and seemed to forbid their return to the earth, which was still invisible. The agitation of the balloon became greater every moment. They cut the cords which held the interior balloon, which consequently fell on the bottom of the external one, just upon the aperture of the tube, which went down into the boat, and stopped it up. At this time the thermometer showed a little above 44°. A gust of wind from below drove the balloon upwards, to the extremity of the vapor, when the appearance of the sun showed them the existence of nature; but now, both the heat of the sun and the diminished density of the atmosphere occasioned such a dilation of the inflammable air, that the bursting of the balloon was apprehended; to avoid which they introduced a stick through the tube that proceeded from the balloon, and endeavored to remove from its aperture the inner balloon, which closed it; but the dilation of the inflammable air pushed the inner balloon so violently against the aperture of the tube, that every endeavor proved ineffectual. During this time they still continued to ascend, until the mercury in the barometer stood not higher than 24.36 inches, which shows their height above the surface of the earth to be about 5,100 feet. In these dreadful circumstances, they thought it necessary to make a hole in the balloon, in order to give an exit to the inflammable air; and the Duke of Chartres, by means of one of the banners, made two incisions, which caused a rent of between seven and eight feet. They then descended very rapidly, seeing at first no object on earth or in the heavens; but a moment after they discovered the fields, and were descending straight towards a lake, into which they must have fallen had they not thrown overboard about sixty pounds weight of ballast, which occasioned their coming down at about thirty feet beyond the edge of the lake. Notwithstanding this rapid descent, occasioned by the great quantity of gas which escaped out of the two rents in the balloon, none of the four adventurers was hurt, but spoke in the highest terms of excitement of the pleasures of their expedition.

These successful aerial voyages were soon followed by others. Blanchard had already ascended several times, when he determined to cross the channel between England and France, which is about 23 miles wide, in a balloon filled with inflammable air. He succeeded in this bold attempt, January 7, 1785, accompanied by an American gentleman, Dr. Jeffries. About one o'clock they left the English coast, and at half-past two, were on the French. Pilatre de Rozier, mentioned before as the first aeronaut, attempted, June 14, 1785, in company with Mr. Romain, to pass from the French to the English side; but the attempt was unsuccessful, and the adventurers lost their lives. M. de Rozier had on this occasion united the two kinds of balloons; under one, filled with inflammable air, which did not alone possess sufficient elevating power, was a second, filled by means of a coal fire under it. Rozier had chosen this

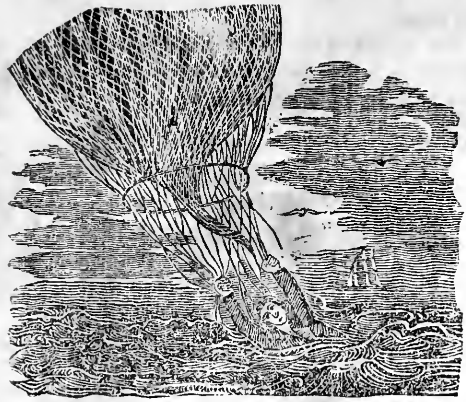
combination, hoping to unite the advantages of both kinds. By means of the lower balloon, he intended to rise and sink at pleasure, which is not possible with inflammable air; for a balloon filled with this, when once sunk to the earth, cannot rise again with the same weight, without being filled anew; while, on the contrary, by increasing or diminishing the fire under a balloon filled with heated air, it can be made to rise and fall alternately. But this experiment caused the death of the projectors. Probably the coals, which were only in a glowing state near the surface of the ground, were suddenly kindled to a light flame as the balloon rose, and set it on fire. The whole machine was soon in flames, and the two aeronauts were precipitated from the air. The condition of their mangled bodies confirms the conjecture that they were killed by the explosion of the gas. This unhappy accident did not deter others; on the contrary, the experiments were by degrees repeated in other countries.

However important this invention may be, it has as yet led to no considerable results. Its use has hitherto been confined to observations in the upper regions of the atmosphere. But should we ever learn to guide the balloon at will, it might, perhaps, be employed for purposes of which we now have hardly an idea; possibly the plan of Professor Robison might be accomplished by the construction of a gigantic balloon, which would enable us to perform an aerial circumnavigation of the earth. During the French Revolution, an aerostatic institution was founded at Meudon, not far from Paris, for the education of a corps of aeronauts, with the view of introducing balloons into armies as a means of reconnoitering the enemy. But this use of balloons was soon laid aside, for, like every other, it must be attended with great uncertainty, as long as the machine has to obey the wind. Among the French, Blanchard and Garnerin have undertaken the greatest number of aerial voyages; among the Germans, Professor Jungius, in Berlin, in 1805 and 1806, made the first. Since that time, Professor Reichard and his wife have become known by their aerial excursions. Even in Constantinople such a voyage was performed, at the wish and expense of the Sultan, by two Englishmen, Barly and Devigne. Blanchard has rendered an essential service to aeronauts by the invention of the parachute, which they can use, in case of necessity, to let themselves down without danger.

The arrangement of the parachute, with reference to its use for aeronautic purposes, may now be more fully illustrated.

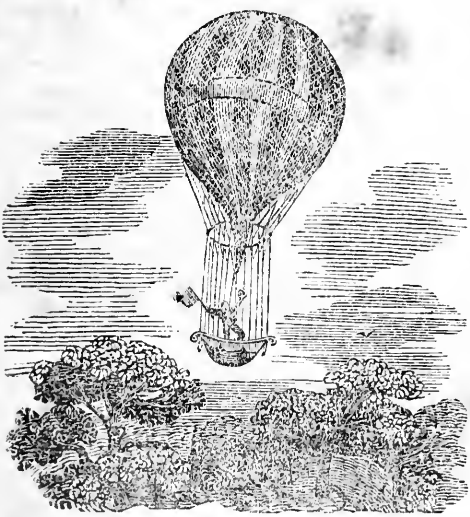
In the right hand figure, M. Garnerin's apparatus is seen as it ascended from St. George's-parade. A cylindrical box, about three feet in height, and two in diameter, was attached by a straight pole to a truck or disc at the top, and from this was suspended a large sheet of linen, somewhat similar to an umbrella. The form it assumed on the descent of the aeronaut is shown in the next figure. When first cut from the balloon, it descended with amazing velocity, and those who witnessed its progress considered the destruction of the aeronaut as certain; but after a few seconds the canvas opened, and the resistance was so great, that the apparatus diminished in its speed, till on its arrival near the earth it was not greater than would have resulted from leaping a height of two feet.

Amongst the unfortunate aeronauts we may place Major Money, who ascended from Norwich, under the full impression that the aerial current would take the balloon in the direction of Ipswich. Scarcely, however, had he attained an altitude of one mile, when a violent hurricane, operating in a new direction, drove the balloon towards Yarmouth. Several small row boats immediately put out from that port, and endeavored to keep pace with the balloon, but without success; and Major Money first touched the sea about nine miles from land, and more than three from any means of assistance.



Our artist has delineated the situation of Major Money at the period we have now been describing, or rather about ten minutes after he had parted with a portion of his clothes and instruments; and it was only by the assistance of a fast sailing cutter, which happened to lay in the track of the balloon, that he was saved, when almost exhausted.

Having thus given a brief account of the early history of the aerostatic art, and of the successive improvements which the balloon has undergone both in its external form and appearance, and the nature of the material used for inflation, we may now speak of the very beautiful machines which are employed for aerial excursions by the aeronauts of the present day.



The preceding illustration exhibits a very picturesque view of the ascent of that veteran, Mr. Green, from the Park, on the occasion of the coronation of his late majesty, George IV. The balloon itself, the form of which is similar to, but infinitely more beautiful than, a pear, is composed of strips of variegated silk, the harmony of which has a particularly pleasing effect on the eye. Over this is thrown an envelope of net-work, which passing down serves as a support to which the car is attached.

The utility of aeronautic studies and experiments has been very much questioned, even by philosophical minds. M. Cavallo, well known in the philosophical world, suggested long ago that small balloons, especially those made of paper, and raised by means of spirits of wine, may serve to explore the direction of the winds in the upper regions of the atmosphere, particularly when there is a calm below; and we see the French aeronauts adopted this idea, that they might serve also for signals in various circumstances, in which no other means can be used; and letters or other small things may be easily sent by them: for instance, from ships that cannot safely land on account of storms, from besieged places, islands, or the like. The larger aerostatic machine, he adds, may answer all the above-mentioned purposes in a better manner; and they may, besides, be used as a help to a person who wants to ascend a mountain or a precipice, or to cross a river; and, perhaps, one of the machines tied to a boat by a long rope, may be, in some cases, a better sort of sail than any that is used at present. Their conveying people from place to place with great swiftness, and without trouble, may be of essential use, even if the art of guiding them in a direction different from that of the wind should never be discovered. By means of these machines the shape of certain seas and lands may be better ascertained; men may ascend to the top of mountains they had never visited before; they may be carried over marshy and dangerous grounds; they may by that means come out of a besieged place, or an island; they may, in hot climates, ascend to a cold region of the atmosphere, either to refresh themselves, or to observe the ice which is never seen below; and, in short, they may be thus taken to several places, to which human art hitherto knew of no conveyance.

New Method of Computing the Moon's Distance from the Earth.—The data on which the computation is made are the Moon's

sideral period, and the force of gravity on the earth's surface. The force of gravity on the earth's surface, as ascertained by the pendulum, is sufficient to make a heavy body descend in vacuo about $16\frac{1}{12}$ feet the first second of its fall. From this fact can be easily ascertained what the sideral period of a body would be, revolving round the earth in vacuo, one semidiameter of the earth from its centre.

When this sideral period is ascertained, then take the moon's sideral period, and say, by the Rule of Three: The squares of these two periods are to each other, as the cubes of the distances from the earth's centre.

We have made the computation, and find the moon's distance to be about sixty semidiameters of the earth from its centre; which corresponds with the general computation founded on the moon's horizontal paralax.

On a Means of effecting an Useful Continued Motion. By J. GORRIE. To the Editor of the American Mechanics' Magazine.

It is in the nature of things that he who under any circumstances attempts an object that has been deemed of impossible attainment, will subject himself to the charge of presumption. If it is an object that has engaged and eluded the ingenuity and wisdom of men for ages, he will be accused of arrogance in supposing that he alone possesses knowledge superior to the rest of mankind. In endeavoring to persuade his fellow men of his success, he must not only encounter the intrinsic difficulties inseparably connected with every such attempt, by vanquishing or preventing objections which naturally present themselves to the most dispassionate understandings, but he must overcome the objections by which the judgments of men are disturbed at the first glance of such a pretension. The doubts of the sceptic, and the shafts of the satirist, are principles always enlisted against such propositions; for there is an almost uncontrollable propensity to persuade ourselves that what has never been found never will appear, and that nothing but folly would look for it. But while it would certainly be characteristic of weakness to admit any proposition, however gravely or plausibly advanced, without due examination, it no more follows, as a true consequence, that he who proposes it is a wild and visionary projector, than it does that he who ridicules it is a wise and practical philosopher.

The failure of the countless schemes for effecting an *useful* continued motion makes me deeply sensible of the good foundation for the doubts which will attend every plan for such an object, and of the necessity of removing preconceived prejudices. With the view of removing these obstacles I have made the preceding remarks; and I shall now call the attention of the reader to the means by which my plan avoids the errors that have caused the failure of its predecessors. Unlike all the plans of which I have seen or heard, I make no attempt by combining the simple mechanical powers, or by any application of magnetism, galvanism, gravitation, or the other *unvarying* laws of nature, to *create* a moving power, but have simply taken advantage of a well known and ever active, though varying, law of nature, to produce a mechanical effect. My project has occurred to me from a plain process of ratiocination on the principle and uses of the *thermometer*; and is, indeed, nothing more than a modified thermometer on a very large scale, with a more expansible fluid than is commonly used. This is not the first time that the plaything of the philosopher has become an instrument of utility and power in the hands of the mechanic.

It is an axiom of mechanics that "whatever communicates or tends to communicate motion to a body is a mechanical force." It is indisputably admitted that all bodies are enlarged on receiving accessions of heat, and in this process of enlargement they exert a mechanical force, and any obstacle which opposes this enlargement sustains an equivalent pressure. This force, when derived from solids, and more particularly from fluids confined in a limited space, may be produced to almost any degree of intensity, by the simple operation of the changes in atmospheric temperature. From this very simple though obvious source of power, I found my theory of a "perpetual motion"; and which I hope to prove, logically, is incontrovertible in its practical application. To this I may add, that I have constructed a machine, rude, it is true, from the absence in this part of the country of mechanical skill of the kind required, but sufficiently accurate to verify the correctness of the principle.

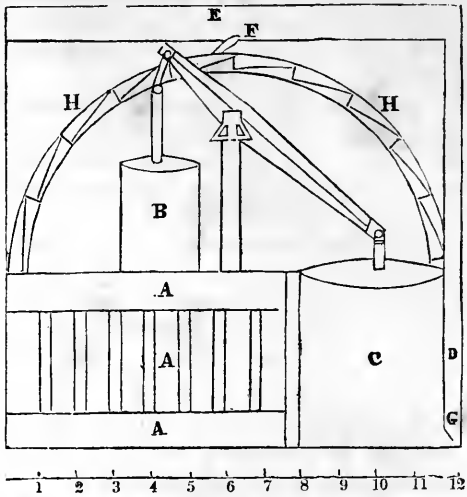
From an examination of a series of thermo-

metric tables, I found that the average change of temperature, or the range of Fahrenheit's thermometer, from the minimum to the maximum, in this country, in the shade, was about fifteen degrees for every day in the year. Experiments on the expansibility of liquids show that ether, alcohol, and the oil of turpentine, (the fluids of the common kind that undergo the greatest changes in these respects,) are expanded six cubic inches in every one hundred cubic inches, on an exposure to an increase of 90° of heat, and consequently sustain an equal diminution of bulk under an equal diminution of temperature. If we employ a gallon of either of those fluids, it will, under the operation of the above laws of nature, undergo an average daily expansion and contraction of 2.74 cubic inches, which, if made to act upon a piston in a cylinder of one inch in diameter, would elevate, and the pressure of the atmosphere would depress it, about three and a half inches daily.

This is the power. It is necessarily of an irregular and intermitting kind, having, with the exception of the numerous daily fluctuations (which would each operate as a moving power) an interval of twenty-four hours between each exacerbation of action; but to convert it into an uniform and continuous motion, there are numerous means obvious to every practical mechanic. The grand object being obtained of moving a piston spontaneously in a cylinder, it will be no difficult matter to apply that power by a working beam, spring, or various other ways, to any mechanical purpose.

In the machine which I constructed, of which the attached figure is a roughly drawn elevation, I have applied the piston to a beam, the farther end of which works a pump large enough to receive thirty pounds of quicksilver. This quantity of mercury is elevated through a tube by the action of the piston, cylinder B, to a cistern twelve inches above the bottom of the pump, and thence is discharged through a graduated orifice, in a small continuous stream (so as to give uniformity of motion) upon an overshot wheel. Reasoning from the comparative incompressibility of fluids, I consider that there is afforded, by the average daily expansion of a gallon of alcohol, and power enough to elevate, not simply thirty, but three hundred or more pounds, of mercury, twelve inches high; while if we give *it*, as I propose, a practical application to a common clock, the daily elevation of ten pounds will be sufficient to keep it in "continual motion."

It is obvious that the cylinder, &c. must be adapted in length to the varying bulk of the expansible fluid in summer and winter.



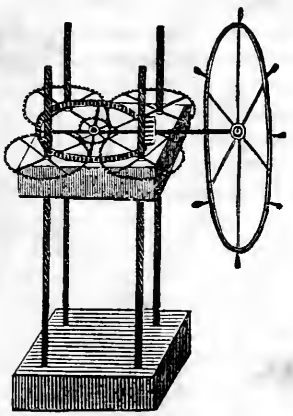
REFERENCES.—A A A, a vessel consisting of 2 common receivers and tubes, (48,) enough to hold a gallon of an expansible fluid. B, a cylinder with a piston, on which the expansion of the fluid in A, produced by change of atmospheric temperature, is to act. C, a pump, with a valve opening inwards, (not seen in the figure.) D, a tube, up which mercury is to be forced by the pump C, into the cistern E. F, a graduated orifice, for discharging the quicksilver on the overshot wheel, H H. G, a valve, to prevent the retrogression of the mercury into the pump C.

That this principle will fulfil the expectations generally entertained of a "perpetual motion," I do not expect, but that it affords a source of power sufficient for the purpose, I have received a sufficient demonstration; and that it can be made an useful improvement in mechanics, no objection has been presented that gives me reason to doubt. It is as yet scarcely more than an incipient idea, having received but a slight examination of one mind, and that not accustomed to such operations.

Columbia, S. C. March 11, 1833.

We understand that Sir David Brewster has, within this last week, made two very remarkable discoveries, which promise to be of some

use to science. In a new salt discovered by Dr. William Gregory, viz. an oxalate of chronium and potash, he has detected the extraordinary property, that one of its images formed by double refraction is of a bright scarlet, while the other image is of a bright blue color. In examining the pure liquid, any hydrous nitrous acid, prepared in the manner which is supposed to yield it in its purest state, he found that the acid actually consisted of two separate fluids, one of which was heavier than the other, and possessed a much higher refractive power.—When the two fluids were shaken, they formed an imperfect union, and separated again by being allowed to remain at rest. What the second fluid is remains to be investigated. It may perhaps turn out to be an entirely new substance. Its physical properties are now under investigation.—[Caledonian Mercury.]



Mr. Dunham's new Patent Screw Press.—We have been much gratified by an inspection of this new invention, a correct engraving of which we insert, and witnessing its operation in pressing paper, at the office of Messrs. Schols & Co., printers, in this city.

It consists of a cast iron bed, on which are erected four iron columns, with a screw on the end of each; the head or platen is attached to four cog wheels, which move it up and down on the columns—the whole being acted upon by a pinion wheel in the centre, thus moving the platen in a perfectly straight line without the least variation, which is a great improvement on the old presses, producing a reduction of friction, a gain of power, and a saving of machinery. The press in question can be constructed with one to ten thousand tons power or more, retaining all its advantages, and can be worked either by manual or horse power, or by machinery, and is peculiarly adapted to the expressing of oils, the pressing of paper, or any thing requiring a perfectly uniform, gradual, and equal motion.

We are informed that one man can, with this press, perform in the same given time an amount equal to that which requires four men with a bar and capstan press. The whole is composed of iron, and built in a substantial and workmanlike manner by Messrs. Fry & St. John, 87 Eldridge-street, requiring but one-fourth part the space occupied by common presses.

The press can be made of almost any size, and at about the same price, as the old fashioned ones, and which we are of opinion in a very short time it will entirely supersede.

Extracts from Lord Brougham's Treatise on the Pleasures and Advantages of Science.

We have seen how wonderfully the *Bee* works according to rules discovered by man thousands of years after the insect had been following them with perfect accuracy. The same little animal seems to be acquainted with principles of which we are still ignorant. We can, by crossing, vary the forms of cattle with astonishing nicety; but we have no means of altering the nature of an animal once born, by means of treatment and feeding. This power, however, is undeniably possessed by the bees. When the queen bee is lost by death or otherwise, they choose a grub from among those which are born for workers; they make three cells into one, and placing the grub there, they build a tube round it; they afterwards build another cell of a pyramidal form, into which the grub grows; they feed it with peculiar food, and tend it with extreme care. It becomes, when transformed from the worm to the fly, not a worker, but a queen bee.

These singular insects resemble our own species, in one of our worst propensities, the disposition to war; but their attention to their sovereign is equally extraordinary, though of a somewhat capricious kind. In a few hours after their queen is lost, the whole hive is in a state of confusion. A singular humming is heard, and the bees are seen moving all over

the surface of the combs with great rapidity. The news spread quickly, and when the queen is restored, quiet immediately succeeds. But if another queen is put upon them, they instantly discover the trick, and, surrounding her, they either suffocate or starve her to death. This happens if the false queen is introduced within a few hours after the first is lost or removed; but if twenty-four hours have elapsed, they will receive any queen, and obey her.

The labors and the policy of the *Ants* are, when closely examined, still more wonderful, perhaps, than those of the *Bees*. Their nest is a city, consisting of dwelling places, halls, streets, and squares into which the streets open. The food they principally like is the honey which comes from another insect found in their neighborhood, and which they, generally speaking, bring home from day to day as they want it. Late discoveries have shown that they do not eat grain, but live almost entirely on animal food and this honey. Some kinds of ant have the foresight to bring home the insects on whose honey they feed, and keep them in particular cells, where they guard them to prevent their escaping, and feed them with proper vegetable matter, which they do not eat themselves. Nay, they obtain the eggs of those insects, and superintend their hatching, and then rear the young insect until he becomes capable of supplying the desired honey. They sometimes remove them to the strongest parts of their nest, where there are cells apparently fortified for protecting them from invasion. In those cells the insects are kept to supply the wants of the whole ants which compose the population of the city. It is a most singular circumstance in the economy of nature, that the degree of cold at which the ant becomes torpid is also that at which this insect falls into the same state. It is considerably below the freezing point; so that they require food the greater part of the winter, and if the insects on which they depend for food were not kept alive during the cold in which the ants can move about, the latter would be without the means of subsistence.

How trifling soever this little animal may appear in our climate, there are few more formidable creatures than the ant of some tropical countries. A traveller, who lately filled a high station in the French government, M. Malouet, has described one of their cities, and, were not the account confirmed by various testimonies, it might seem exaggerated. He observed at a great distance what seemed a lofty structure, and was informed by his guide that it consisted of an ant hill, which could not be approached without danger of being devoured. Its height was from fifteen to twenty feet, and its base thirty or forty feet square. Its sides inclined like the lower part of a pyramid, the point being cut off. He was informed that it became necessary to destroy these nests, by raising a sufficient force to dig a trench all round, and fill it with faggots, which were afterwards set on fire; and then battering with cannon from a distance, to drive the insects out and make them run into the flames. This was in South America; and African travellers have met with them in the same formidable numbers and strength.

The older writers of books upon the habit of some animals abound with stories which may be of doubtful credit. But the facts now stated, respecting the Ant and Bee, may be relied on as authentic. They are the result of very late observations and experiments, made with great accuracy by several most worthy and intelligent men; and the greater part of them have the confirmation arising from more than one observer having assisted in the inquiries.* The habits of *Beavers* are equally well authenticated, and, being more easily observed, are vouched by a great number of witnesses. These animals, as if to enable them to live and move either on land or water, have two webfeet, like those of ducks or water dogs, and two like those of land animals. When they wish to construct a dwelling place, or rather city, for it serves the whole body, they choose a level ground with a stream running through it; they then dam up the stream so as to make a pond, and perform the operation as skilfully as we could ourselves. Next they drive into the ground stakes of five or six feet long in rows, wattling each row with twigs, and pudding or filling the interstices with clay, which they ram close in, so as to make the whole solid and water-tight. This dam is likewise shaped on the truest principles; for the upper side next the water slopes, and the side below is perpendicular; the base of the dam is ten or twelve feet thick; the top or narrow part two or three,

* A singular circumstance occasioned this in the case of Mr. Huber, by far the most eminent of these naturalists; he was quite blind, and performed all his experiments by means of assistants.

and it is sometimes as long as one hundred feet.* The pond being thus formed and secured, they make their houses round the edge of it; they are cells, with vaulted roofs, and upon piles: they are made of stones, earth, and sticks; the walls are two feet thick, and plastered as neatly as if the trowel had been used. Sometimes they have two or three stories for retreating to in case of floods; and they always have two doors, one towards the water, and the other towards the land. They keep their winter provisions in stores, and bring them out to use; they make their beds of moss; they live on the bark of trees, gums, and crawfish. Each house holds from twenty to thirty, and there may be from ten to twenty-five houses in all. Some of their communities are larger than others, but there are seldom fewer than two or three hundred inhabitants. In working they all bear their shares: some gnaw the trees and branches with their teeth, to form stakes and beams; others roll the pieces to the water; others, diving, make holes with their teeth to place the piles in; others collect and carry stones and clay; others beat and mix the mortar; and others carry it on their broad tails, and with these beat it and plaster it. Some superintend the rest, and make signals by sharp strokes with their tail, which are carefully attended to; the beavers hastening to the place where they are wanted to work, or to repair any hole made by the water, or to defend themselves or make their escape, when attacked by an enemy.

The fitness of different animals, by their bodily structure, to the circumstances in which they are found, presents an endless subject of curious inquiry and pleasing contemplation. Thus, the *Camel*, which lives in sandy deserts, has broad spreading hoofs to support him on the loose soil; and an apparatus in his body by which water is kept for many days, to be used when no moisture can be had. As this would be useless in the neighborhood of streams or wells, and as it would be equally so in the desert where no water is to be found, there can be no doubt that it is intended to assist in journeying across the sands from one watered spot to another. There is a singular and beautiful provision made in this animal's foot, for enabling it to sustain the fatigue of journeys under the pressure of its great weight. Beside the yielding of the bones and ligaments, or bindings, which gives elasticity to the foot of the deer and other animals, there is in the Camel's foot, between the horny sole and the bones, a cushion, like a ball, of soft matter, almost fluid, but in which there is a mass of threads extremely elastic, interwoven with the pulpy substance. The cushion thus easily changes its shape when pressed, yet it has such an elastic spring, that the bones of the foot press on it uninjured by the heavy body which they support, and this huge animal steps as softly as a cat.

Nor need we flee to the desert in order to witness an example of skilful structure: the limbs of the *Horse* display it strikingly. The bones of the foot are not placed directly under the weight; if they were in an upright position they would make a firm pillar, and every motion would cause a shock. They are placed slanting or oblique, and tied together by an elastic binding on their lower surfaces, so as to form springs as exact as those which we make of leather and steel for carriages. Then the flatness of the hoof, which stretches out on each side, and the frog coming down in the middle between the quarters, adds greatly to the elasticity of the machine. Ignorant of this, ill-informed farriers nail the shoe in such a manner as to fix the quarters, and cause permanent contraction of the bones, ligaments, and hoof—so that the elasticity is destroyed; every step is a shock; inflammation and lameness ensue.*

The *Rein-deer* inhabits a country covered with snow the greater part of the year. Observe how admirably its hoof is formed for going over that cold and light substance, without sinking in it, or being frozen. The under side is covered entirely with hair, of a warm and close tex-

* If the base is twelve and the top three feet thick, and the height six feet, the face must be the side of a right-angled triangle, whose height is eight feet. This would be the exact proportion which there ought to be, upon mathematical principles, to give the greatest resistance possible to the water in its tendency to turn the dam round, provided the materials of which it is made were lighter than water in the proportion of 44 to 100. But the materials are probably more than twice as heavy as water, and the form of so flat a dike is taken, in all likelihood, in order to guard against a more imminent danger—that of the dam being carried away by being shoved forwards. We cannot calculate what the proportions are which give the greatest possible resistance to this tendency, without knowing the tenacity of the materials, as well as their specific gravity. It may, very probably, be found that the construction is such as to secure the most completely against the two pressures at the same time.

* Mr. Bracey Clark has contrived an expanding shoe, which, by a joint in front, opens and contracts, so as to obviate the evils of the common process.

ture; and the hoof, altogether, is very broad, acting exactly like the snow-shoes which men have constructed for giving them a larger space to stand on than their feet, and thus avoid sinking. Moreover, the deer spreads the hoof as wide as possible when it touches the ground; but, as this breadth would be inconvenient in the air, by occasioning a greater resistance while he is moving along, no sooner does he lift the hoof than the two parts into which it is cloven fall together, and so lessen the surface exposed to the air, just as we may recollect the birds doing with their bodies and wings. The shape and structure of the hoof is also well adapted to scrape away the snow, and enable the animal to get at the particular kind of moss (or *licken*) on which he feeds. This plant, unlike others, is in its full growth during the winter season; and the Rein-deer accordingly thrives from its abundance, at the season of his greatest use to man, notwithstanding the unfavorable effects of extreme cold upon the animal system.

There are some insects of which the males have wings, and the females are grubs or worms. Of these, the *Glow-worm* is the most remarkable: it is the female; and the male is a fly, which would be unable to find her out, creeping as she does in the dark lanes, but for the shining light which she gives, to attract him.

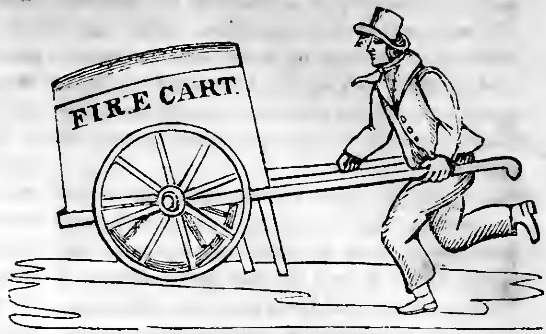
There is a singular fish found in the Mediterranean, called the *Nautilus*, from its skill in navigation. The back of its shell resembles the hulk of a ship; on this it throws itself, and spreads two thin membranes to serve for two sails, paddling itself on with its feet, or feelers, as oars.

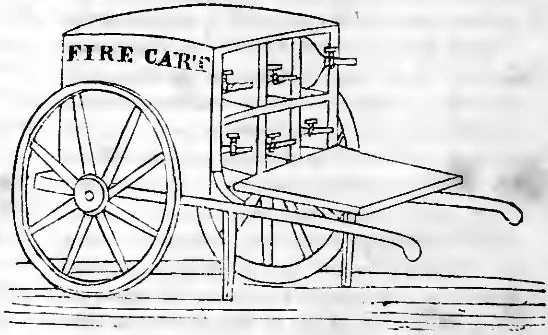
The *Ostrich* lays and hatches her eggs in the sands: her form being ill adapted for sitting on them, she has a natural oven furnished by the sand, and the strong heat of the sun. The *Cuckoo* is known to build no nest for herself, but to lay in the nests of other birds; but late observations show that she does not lay indiscriminately in the nests of all birds; she only chooses the nests of those which have bills of the same kind with herself, and therefore feed on the same kind of food. The *Duck*, and other birds breeding in muddy places, have a peculiar formation of the bill: it is both made so as to act like a strainer, separating the finer from the grosser parts of the liquid, and it is more furnished with nerves near the point than he bills of birds which feed on substances more exposed to the light, so that being more sensitive, it serves better to grope in the dark stream for food. The bill of the *Snipe* is covered with a curious net work of nerves for the same purpose; but the most singular provision of this kind is observed in a bird called the *Toucan*, or *Egg-sucker*, which chiefly feeds on the eggs found in birds' nests, and in countries where these are very deep and dark. Its bill is broad and long; when examined, it appears completely covered with branches of nerves in all directions; so that, by groping in a deep and dark nest it can feel its way as accurately as the finest and most delicate finger could. Almost all kinds of birds build their nests of materials found where they inhabit, or use the nests of other birds; but the *Swallow of Java* lives in rocky caverns on the sea, where there are no materials at all for the purpose of building. It is therefore so formed as to secrete in its body a kind of slime, with which it makes a nest, much prized as a delicate food in Eastern countries.

A Plan for the Speedy Extinction of Fires.
[From Captain Manby's Circular to Insurance Companies in England.]

It must be obvious that the ready extinction of fire depends entirely on the facility with which water is brought to act upon it at its commencement; and that, when left uncontrolled during the delay of engines arriving, the procurement of water, and the further delay of getting the engines into full action, it reaches a height at which its reduction is highly doubtful, and at least very difficult. Many instances of destruction by fire have been caused by obstructions to the conveyance of engines to the spot, or from the impossibility of procuring water to enable them to act when they have arrived; and in every case some delay necessarily takes place in preparing the engines, even when water is at hand. It is a well-known fact that many of the great and destructive fires in London and other large towns, where water-pipes are laid, might have been controlled if water could have been obtained in time. In towns not so provided, villages, the detached residences of gentlemen, and other buildings in the country, the want of water at hand, or other means of extinction, makes their total destruction in case of fire almost inevitable.

From observations which I have made in wit-





nessing fires, and from information of those persons constantly employed on such occasions, I am assured that a small quantity of water, well directed and early applied, will accomplish what, probably, no quantity would effect at a later period. This has excited my attempts to provide some prompt and efficient means by which the anxious and often important interval of delay would be obviated, and the fire opposed on the first alarm, thereby not allowing the flames to increase in fury; which so often occurs, that the efforts of the fireman are exerted rather with the hope of preventing the extension of the calamity to other buildings, than to save that in which it first broke out.

To attain this object, I propose a Fire Cart of light construction, requiring but one person to convey it to the spot, and apply a fluid, in the most efficacious manner, from portable vessels or engines, on a principle very long known—the artificial fountain in pneumatics. The engines are to be kept always charged, and one when slung across the body of a watchman or servant is easily carried to any part of the builing, however difficult of access. The management required is simple: for on opening the stop-cock, the pressure of condensed air instantly propels a stream that can be directed with the most exact precision on the part in combustion,—a circumstance extremely important, when the incipient fire is not within the reach of effort by the hand, and when the air, heated by the flames, prevents approach to cast water upon it by common means.

Every fire, even the greatest, must arise from small beginnings, and when discovered in its infant and commencing state, is easily to be kept down and prevented from becoming destructive, if means of early application were at hand. We often hear of the alarm of fire given by watchmen long before the arrival of engines on the spot, and, if they were provided with a fire cart, the alarm of the watch and application of means of extinction would be simultaneous.

The cart contains six engine s, each charged with the impregnated solution of an ingredient best adapted to extinguish fire. When the first engine has expended its store of antiphlogistic fluid, a supply of others in succession may keep up a constant discharge until regular engines and plenty of assistance arrive, should the fire not be entirely subdued by these first efforts.

When a small quantity of simple water is cast on materials in a state of violent combus-

tion it evaporates into steam from the heat, and the materials thus extinguished readily ignite again; the addition of incombustible ingredients consequently becomes necessary to make quality supply the place of quantity, and thus with the smallest portion prevent the fire rekindling.

To give the most extinguishing properties to common water has engaged the experimental attention of many in different countries,* and it has been rendered by them more effective to extinguish fire than forty times the same quantity of common water (a circumstance not speculative, but conformed by trial made upon buildings erected for that purpose); but the simple ingredient of pearl-ash dissolved in water when applied on burning substances, forming an incrustation over the surface extinguished, and thereby preventing the access, has in my estimation a decided preference; it has likewise the superior recommendation of the readiness with which any person may imbue the water with it, while the compounds cannot be had but at considerable cost, nor be prepared without labor and nice accuracy in their respective proportions. Thus at the moderate ratio of twenty times increasing the quality, the cart would convey an extinguishing fluid equal to one tun and a half of common water.

Specification in reference to the Apparatus belonging to the Fire Cart.—Each machine is a strong copper vessel, of a cylindrical form, two feet in length and eight inches in diameter, capable of containing four gallons; a tube of the same metal, of one-fourth of an inch in diameter, curved so that its end is carried to the side of the vessel, with a stop-cock and jet-pipe, the vent of which is one-eighth of an inch in diameter at its top, reaches to within half an inch of the bottom, and is to be screwed so closely into the neck of the vessel as to preclude the possibility of the escape of the air.

Three gallons of water, holding in solution any ingredients* best adapted to extinguish fire, are to be put into the vessel, and then the room remaining for the fourth gallon to be filled with closely condensed air; to effect which, the jet-pipe is to be unscrewed, the condensing-syringe fixed in its place, and the air to be pumped in, to the utmost power of the strength of the vessel to contain it; the stop-cock is then to be closed, condensing-syringe taken off, and the jet-pipe replaced.

On turning back the stop-cock, the condensed air re-acts on the water, and casts it to a height proportioned to the degree of condensation.

That the machine may be more easily carried, where access is difficult, it is put into a leathern case with a strap, and, slung over the shoulders of the bearer, is thus conveyed easily, and then directed with the utmost precision to the point requiring the water.

As directions for the effective arrangement of fire carts in populous places, the following plan I should propose: That at each watch-house, from the time of the watch setting, there should be in attendance a regular fireman instructed in the use and management of the apparatus; and that each parish should be provided with one or more fire carts, according to its extent or number of wards, and the vessels or engines composing the complement of the cart to be kept charged ready for being immediately applied. When watch-boxes or stations are at a considerable distance from the watch-house, some central watch-box should have a single engine lodged ready for application, to be brought on the alarm by the watchman, and delivered to the fireman, who repairs to the spot on the alarm of fire being given with as much expedition as possible. Should the fire have broke out near the depot of the fire cart, the fireman in attendance will take the cart with him, or an engine from it ready to apply; if otherwise, the watchmen will each bring an engine, which the fireman will expend, and by receiving from others their engines, a regularly-continued and well-di-

* 1734. M. Fuches, a German physician, by throwing balls into the fire, containing certain preparations, which burst with violence, instantly quenched the fire.

1761. Zachary Grey used the same process, in which were alum, sal ammoniac, and other saline matters, with water.

In the same year Dr. Godfrey, in a public exhibition in a house erected for that purpose near Mary-le-bone, applied the like ingredients with great success, by the action of confined gunpowder only, which, exploding, dispersed the solution on the materials in combustion, and effectively extinguished the same.

1792. M. Von Ahen, at Stockholm, made numerous public experiments to show the effects of several combined ingredients to render materials entirely incombustible; he is stated to have subdued an artificial fire by two men and forty measures of preparation, that would have required twenty men and fifteen hundred of the same measures of simple water.

In the same year, M. Nil Moshein made many public exhibitions to confirm that combustible materials might be made perfectly incombustible; as also did Mr. W. Knox, of Gottenburg.

* Pearl-ash, dissolved in water, when applied on burning substances, forms an incrustation over the surface extinguished, and prevents that part from reinflaming.

rected stream will be kept up, which, from the early opposition to the fire, will no doubt check the flames, if not entirely subdue the fire; should the distance be considerable, the fireman, aided by a watchman, would convey the cart to a place on fire with as much dispatch as possible.

New-York, March, 1833.

To the Editor of the Mechanics' Magazine:

Sir,—In your last number you have given an account of Russell's Hydraulic Press, copied from the London Mechanics' Magazine, and put forth there as a recent invention. I beg to inform you that I assisted to construct a press on the same principle, in June, 1827, for Mr. Ward, Tallow Melter, in Third street, in this city, where it is now in use, and has been ever since that period. Now I think that sufficient notice has not hitherto been taken of inventions that have been made in this country. I am an old countryman, and I can assure you I have every disposition to do all possible justice to Brother Jonathan, and I do hope that in this instance, as well as in all others that come under your notice, you will not fail to make public the claims the people of this country have for ingenuity and industry in all that appertains to the Useful Arts. There is some trifling difference between the press at Mr. Ward's, and that of Russell's, as described in your last—but nothing that affects the principle; however, on that head you can satisfy yourself by seeing it. I am, Sir, your obedient servant,

A Mechanic from Scotland.

[We have seen the press alluded to by our esteemed correspondent, and certainly it is constructed exactly on the same principle as Mr. Russell's. There are several in operation in this city, but we believe none of them have the railway attached, which is a great acquisition. It does not exactly appear that the Editor of the London Mechanics' Magazine, or his correspondent, Mr. Russell, who claims to be the inventor, has put it forth as a very recent invention. Mr. R. in his letter says, that he "has made and constructed several presses of this description," but he does not make us acquainted with the period when he made the first—although as far as we can gather from his letter he claims the invention. That similar presses have been in use here for the last seven years is quite certain, and, the probability is, much longer. We should be sorry to call in question the claims of Mr. Russell, but we have had several communications of a similar nature to that of *a Mechanic from Scotland,* and most of them claim the invention for America. Our only wish is to elucidate the truth, and perhaps some of our correspondents can assist us in the attempt.—Ed. M. M.]

Gipseys of Granada. From an unpublished work—by the Author of "A Year in Spain." [From the Knickerbacker.]

Cervantes begins his beautiful novel of the Gitanilla, in which he illustrates the pranks of the Gipseys, with the following not very flattering exordium: "It would seem that the Gitanos and Gitanas were solely born into the world to fill the station of thieves. They are brought up among thieves; they study the profession of thieves; and finally end by becoming thieves, the most current and thorough-paced on the face of the earth." The history of our species furnishes no study more singular than that of this unaccountable race, which, emigrating from the east, overran the whole of Europe, and pushed its way onward, not by the force of the sword, but by begging and stealing; and at the same time that they conformed in some particulars of dress, manners, customs, and religion, to the countries in which they settled, in others retained every where a common character, common propensities, and common occupations.

The Gipseys are found in no part of Spain except Andalusia, which, in their soft and lisping Spanish, they call *la tierra de Dios—la tierra de Maria Santissima:* the land of God—the land of the most holy Virgin.—They either live in the ruinous purlieus of the great cities, or else wander from place to place, the women carrying their children naked, slung from their shoulders, or dangling with one arm around them upon their hips. In Andalusia, as elsewhere, they gain their bread by tinkering, stealing, and fortune-telling; and preserve the common tradition of an Egyptian descent. It is in Granada, however, that they most abound, just as the skippers are found in greatest numbers in the best cheese. They have their habitations in the caves of the Albaycin, where they practice little arts in lock and spoon making and basket work, their commodities having the common reputation of being worthless and catch-penny. To vend them, they take their stations in the Vivarambla, where they

may always be seen seated at the shady side of the square, and never shifting their births until dislodged by the sun. Their chief revenue, however, arises from shaving their favorite water dogs, of which there is one in almost every family; and I have often been amused at seeing the four paws of one of these animals, as he impatiently submitted to this process of decoration, held by as many young Gipseys in as many different directions, whilst the old crone their mother divested him of his fleece. These people are almost universally tall and well made, their figures and carriage having in a rare degree the air of freedom and unconstraint. The women are very beautiful, their features, as well as those of the men, being very regular; with an Asiatic complexion and cast of countenance; long, straight, and very black hair; full dark eyes, and teeth of pearly whiteness. They are all fond of appearing in the worn out finery of the Andalusian dandies, and have a taste for elegance, though it be even in rags. Their pranks are often exhibited on the Spanish stage, to the great delight of the audience, who receive their quaint practical jokes and less innocent rogueries with the greatest glee. Indeed, they have the character of being a light-hearted and happy race, and, notwithstanding their vicious propensities, are looked on with an extra share of that indulgence which is extended to vagrants of all classes in Spain.

There is much in the cast of countenance, complexion, and unfettered conformation of these Gipseys, in connection with their mendicant air, and the distinctness of their appearance, character, and sympathies, from those of the Spaniards around them, to remind an American of the vagrant Indians whom he has seen loitering about the frontier settlements of his native country. The Gipseys of Spain do not, however, excite the same sympathy as our unhappy aborigines. They came to that country of their own accord, and with a view to better their condition, bringing their vices with them, and making them instrumental to self support and to the preservation of their identity. But the Indians, instead of dispossessing, are the dispossessed; their degradation, instead of being derived from their savage state, has supplanted the wild virtues that adorned it, and is at once the result of civilized encroachment and the efficient cause of their ruin.

It was in order to see something of the domestic economy of this strange race, of whom we daily meet many in the streets of Granada, that we one morning took a walk to the caves of the Albaycin, where they have their subterranean habitations. Crossing the ravine of the Daro, and passing through the more populous portion of the Albaycin, whose houses are often incorporated with the ruins of walls, that mark the gradual expansion of Granada, as it augmented its population in the days of the Saracens, we began at length to ascend the more precipitous portion of the rival mountain, where it looks towards the valley of the Daro and the fortress of the Alhambra. The Albaycin may be called the rival of the Alhambra, not only from its position immediately opposite, the two mountains being drawn up on either side of the Daro, and frowning upon each other, the pillars of Hercules in miniature; but because in Moorish days it was crowned with a fortress of nearly equal strength, which sometimes arrayed itself in hostility. When two kings reigned, not only in the same kingdom, but in the single city of Granada, it was the fortress of the Albaycin that formed the court and strong hold of Boabdil el Chico. Of this fortress scarce a vestige now remains; it doubtless dates its demolition from the period when, after the conquest, the Moriscos were compelled to take up their abode within the precincts of the Albaycin.

As we went on ascending, the streets of the Albaycin passed gradually into zig-zag pathways, winding their way up the acclivity; and the houses rising above each other along the hill side, gave place to caves artificially hollowed beneath the surface of the earth. The whole superior part of the mountain was perforated like a honey comb, and containing within its bowels a numerous population, of which, however, none of the ordinary indications could be discovered, except the wreaths of thin smoke which rose in every direction, curling among the prickly-pear bushes, which covered the whole surface, and furnished food to the poor inhabitants who lived below. At one of the first caves we managed an invitation to walk in, by asking a decent old woman for some water. When within the door, and we began to recover our sight, we found ourselves in an apartment of regular figure, and wanting in none of the comforts of life. A fire-place stood in front of the entrance, its chimney being perforated upwards through the rock. On the right was the door of the bed-room; it had a circular window or loop hole, was very clean and neat, and was ornamented with crosses, artificial flowers, and rude paintings of the saints.

There were other apartments penetrating farther into the recesses of the mountain, and which received no light from without; these served for sleeping chambers and store rooms. The rock here, like that of the adjoining mountain, which contains the Mazmorras, is of a soft nature and is easily cut, but hardens by exposure to the air. The caves that are hewn in it are more comfortable than the ordinary habitations of the poor, keep out the weather effectually, and being less subject to changes of temperature, are comparatively warm in winter and cool in summer.

Taking leave of our old woman and her cave, we proceeded eastward along the acclivity, until we found ourselves among the more wretched of these subterranean dwellings, the fit abode of Gipseys, vagabonds, and robbers. Having singled out one which we supposed to belong to the first of these honorable classes, from a group of tawny and more than half naked children, whom we found at their gambols before the door, we took the liberty of entering it, after the utterance of an *ave maria purissima*. We found no one within but a young Gipsey girl, seated on the stone floor, surrounded by a litter of straw, which she was sleepily weaving into braid for a bonnet. Beside her was a wild, shaggy dog, which, like those of our Indians, seemed to have adopted himself to the strange life of his masters, and gone back to his original and wolf-like condition. The dog is an accommodating animal; not only in manners, habits, and character, but even in appearance, he learns to assimilate himself to his owner. The dog of a prince takes something of a prince's pomposity; the butcher's dog shares in the butcher's fierceness; the dog of a thief may be easily known by his skulking, hang-gallows air; and that of the poor beggar learns to look as humble and imploring as his master. The theory may fail as often as any other theory; but at all events it applied to the treacherous cur who now growled at our intrusion, until it was sanctioned by his mistress; when, though he ceased his menacings, he took his station beside her, and still kept a watchful and lowering eye upon us. The young woman too seemed embarrassed by our presence; and when we would have our fortunes told by her, she pleaded ignorance, bade us come when her mother should be there, and appeared willing to be rid of us. Ere we relieved her of our presence, we had time to remark that, though neither very clean nor very tidy, she was yet pretty as Preciosa herself. Her features were regular and expressive, with glowing eyes and a form finely moulded and unperverted by artificial embarrassments. She had moreover a modest look, and seemed to justify the idea, that chastity could exist, as it is said to do, in so humble and unfettered a condition. Indeed, whatever may be the vices of the Spanish Gipseys, Cervantes tells us that they respect this virtue both in their wives and damsels, forming none but permanent connexions, which, though not sanctioned by matrimony, are only broken by common consent. He gives them credit too for assuming, in an eminent degree towards each other, the laws and obligations of friendship. They do not take the trouble to pursue crimes committed among them beyond the tribunals of the country; but, like many others in Spain who are not Gipseys, execute justice on their own account.

A LIVING LAMP.—The aborigines of South America, in the *fire-fly*, (the *elater noctilucus*,) had a *living lamp* provided for them by Divine Beneficence, which, supplied from itself, required no art to trim it, no combustible material to feed it. Eight or ten of these insects afford light equal to that of a candle: they illuminate the house—they serve to direct the traveller. On Sir Thomas Cavendish and Sir Robert Dudley landing in the West Indies, they were struck with astonishment at the moving lights of these curious insects in the woods, and, impressed with the idea that the Spaniards were advancing, precipitately returned to their ships.—[The Voice of Humanity, No. X.]

Who first invented Steamboats. By ROBERT LYON. [From the London Mechanics' Magazine.]

In the Penny Magazine of the Society for the Diffusion of Useful Knowledge, there appeared lately an article extracted from an account published at New-York, awarding to Robert Fulton, of America, the right and merit of being the original inventor of steamboats. Knowing as I did the complete falsehood of the thing, I wrote them, and asked them if the dissemination of a notorious falsehood was the diffusion of useful knowledge? If so, I had nothing to add; but, on the other hand, if the correction of falsehood were a matter of any consequence to them (as I give them credit for not wilfully sinning), I would put them right. To make surety doubly sure, I referred them for proof to the

Journals of the Royal Society of London, where they would find ample proof that they were not only doing a very great injustice to their own country, but likewise to the memory and family of the deceased Mr. William Symington, who was the man who had taught Fulton how to construct the machinery to impel vessels by steam.

What then must have been my surprise, Sir, when a Society, at the head of which is Lord Brougham, in place of referring to home documents to correct a most palpable falsehood, after some delay, and in a most flippant manner, replied to my communication by saying, they were content to let the matter rest as it was, as Judge Story's account of the matter from New-York was fully sufficient for them—*the plan of their work not permitting them to sift out the truth.*

Desiring most sincerely, Sir, that right alone should prevail over might, is the wish of ROBERT LYON.

Willowfield, Upper Clapton, Middlesex,
December 24th, 1832.

Applegath and Cowper's Improvement on Koenig's Printing Machine. [From Nicholson's Operative Mechanic.]

[We present our readers with a detailed account of this ingenious improvement, which in Europe has attracted the attention of the curious and the learned for a considerable time past. It has been brought into practical operation in many of the large printing offices in London, particularly in newspaper establishments. By it is printed the "Times," "The Morning Herald," "The Morning Chronicle," the "Ballott," the "John Bull," "Observer," "The Penny Magazine," issued by the Society for diffusing Useful Knowledge, (of which 130,000 are published weekly,) and several others of the most popular leading journals, as well as several publications, which, from their extraordinary cheapness, (considering that in England there is yet a consideradle tax on knowledge,) have very extensive circulation. It is an improvement on Koenig's invention, by discarding forty wheels which he had introduced, and he must be a bold man that will say that as much credit is not due to the improvers for the getting rid of these wheels, as to the original projector *for placing them there.*—ED. M. M.]

A perspective view is represented by fig. 1, and a longitudinal section, to explain the manner in which the paper passes through to receive the impression upon both sides, and the mode of applying the ink to the surface of the types by fig. 2. Though in these figures all the material motions of the machine are displayed, yet some of the minute parts, which produce the various movements, have been omitted, in consequence of the diminutive scale of the figures, which is only about one-third of an inch to a foot.

The supply of the blank paper is laid upon a support, or table, A, from whence the sheets are taken, one by one, by a boy, standing upon an elevated platform, who lays them out upon the table B, which has a number of narrow linen tapes or girths passing across its surface. These tapes are formed into endless bands, which extend round the cylinders, or rollers, C and D, in such a manner that when the rollers are turned round, the motion of the tapes will carry the sheet of paper along with them, and deliver it over the roller E, where it is seized between two systems of endless tapes, passing over a series of rollers to keep them extended. These endless tapes are so adapted, in number and position, as to fall between the pages of printing, and also on the outsides, or beyond the margin of the printing; they may, therefore, remain in contact with the sheet of paper on both sides during its whole passage through the machine; by which means, the paper being once received or taken in between the two systems of endless tapes, it will be capable of continuing its motion along with the tapes, in order to bring it into a situation to be printed on both sides, without destroying the register (or coincidence of the pages on the opposite side of the sheet.) F and G represent the two main cylinders, which effect the pressure upon the paper. They are mounted upon strong axes, which turn in stationary bearings affixed to the main frame of the machine. H and I are two intermediate cylinders, situated upon axes between the main cylinders. Their use is to effect the inversion of the sheet of paper, in order to print the opposite side.

We must now describe the manner in which the two systems of endless tapes before mentioned are arranged, to give a clear idea of the operation of the machine. We will suppose one system of tapes to commence at the upper part of the roller E, from whence they proceed in contact with the under portion of the circumference of the main cylinder F; they then pass over the upper part of the intermediate cylinder H, and under the intermediate cylinder I, from whence they proceed to encompass a considerable

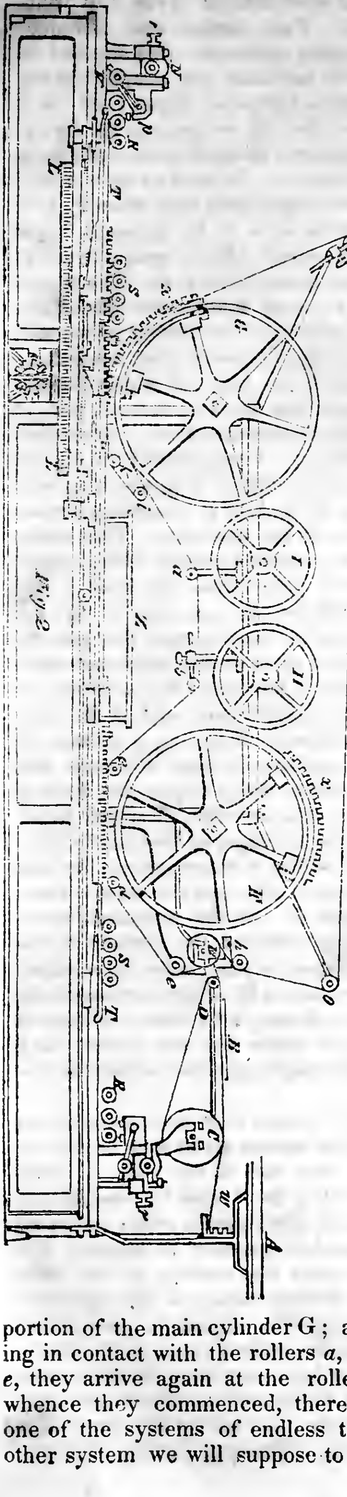


Fig. 2.

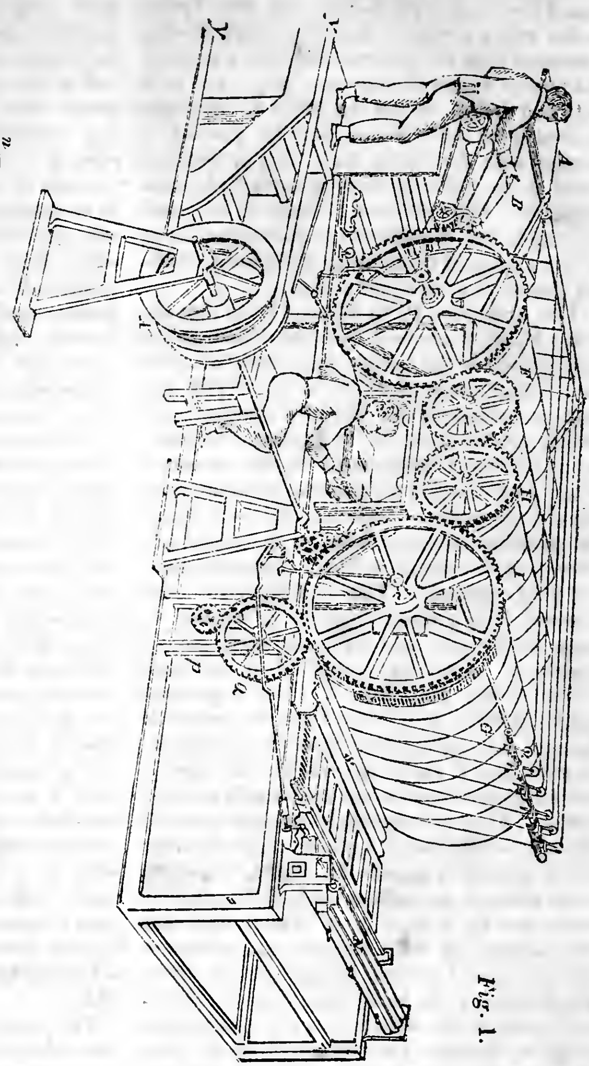


Fig. 1.

portion of the main cylinder G; and by passing in contact with the rollers *a*, *b*, *c*, *d*, and *e*, they arrive again at the roller E, from whence they commenced, thereby forming one of the systems of endless tapes. The other system we will suppose to commence at the roller *h*. They are equal in their number to the tapes already described, and correspond with them also in their place upon the cylinders, so that the sheets of paper may be securely held between them. The second tapes descend from the roller *h* to the roller

E, where they meet and coincide with the first system, in such a manner that the tapes proceed together under the main cylinder F, over the cylinder H, under the cylinder I, and round the main cylinder G, until they arrive at the roller *i*, where they separate; having remained thus far in actual contact, except at the places where the sheets of paper are held between them. From the roller *i*, the paper descends to the roller *k*, and by passing in contact with the rollers *m*, *n*, and *o*, they arrived at the roller *h*, from whence they commenced. Thus the two systems of the endless tapes are established and arranged so as to be capable of circulating continually, without interfering with each other.

The cylinders, P, G, H, and I, as also the roller E, are connected by toothed wheels, as represented in the perspective view, so as to cause their circumferences to move with one uniform velocity, and thereby prevent any sliding or shifting of the two systems of tapes over each other during their motion, as much of the perfection of the printing depends upon this circumstance. Separate forms of types for printing the two sides of the sheet are placed at a certain distance asunder, upon one long carriage. This carriage, with the forms of type secured upon it, is adapted to move backwards and forwards upon steady guides or supporters attached to the main frame of the machine, in such a position that the surface of the types may be operated upon by the circumference of their respective cylinders F and G, to produce the impression as the carriage moves backwards and forwards. This reciprocating movement of the carriage is effected by a pinion fixed upon the end of a vertical spindle K, fig. 2, engaging in the teeth of an endless rack, L L, which is connected by a system of levers with the type carriage, in such manner that, when the pinion is turned round, it engages at alternate periods in the teeth formed upon the opposite side of the rack L L, and, consequently, on the opposite circumference of the pinion; thereby a continuous motion of the pinion communicates a reciprocating motion to the rack and carriage. The verticle spindle K is turned by a pair of bevelled wheels from the pinion P, fig. 1, which receives its motion by an intermediate wheel, Q, from the toothed wheel upon the end of the main cylinder G.

The mechanism for furnishing and distributing the ink upon the surfaces of the types in this machine, is very ingeniously arranged, and performs its operations with great certainty. It is one of the most important points, and the most difficult to effect in printing machines. Two similar and complete systems of inking apparatus, one situated at each end of the machine, are adapted to ink their respective forms of types; we will therefore describe, by references to fig. 1, the inking apparatus situated at the right hand end of the machine. It consists of a cylindrical roller, N, which has a slow rotatory motion communicated to it by a catgut band passing round a small pulley, upon the end of the axis of the main cylinder, G. The roller, N, is adapted to carry down a thin film of ink upon its circumference, by turning in contact with a mass of ink disposed upon a horizontal plate of metal, the edge of which plate is ground straight, and fixed by screws, *r*, *r*, at a small adjustable distance from the surface of the said roller. V represents an elastic composition roller, which is mounted upon a frame turning in an axis *p*, extending across the main frame of the machine. This roller is connected by cranked levers, with a small eccentric circle fixed upon the end of the axis of the cylinder G, (as seen in fig. 1,) which causes it to move round the axis, *p*, and remain for a short period in contact with the surface of the ink roller N, (as seen by the position at the left hand end of the machine, fig. 2,) thereby receiving a portion of ink upon its surface; it then descends and rests with its whole weight upon the surface of a flat metal plate or table, T, which is affixed to the type carriage, so that the reciprocating motion of the carriage causes the ink table T to receive ink upon its surface from the elastic roller V. In this situation, when the type carriage returns, the surface of the table T is obliged to pass under three small elastic rollers seen at R, which are mounted upon pivots in a frame, with liberty of motion up and down, in order that the rollers may bear with their weight upon the surface of the table.

The frame in which they are centered has also a slight end motion given to it, by the inclined form of the end of the table T bearing against a roller fixed upon the said frame. Thus the small composition roller operates in a very complete manner to equalize the supply of ink over the surface of the table T, and by the farther motion of the type carriage, the ink table is caused to pass under four small elastic rollers (seen at S), which in like manner bear with their weight upon the surface of the table (but without end motion), and thereby take up the ink upon their circumferences. The type carriage then re-

turns, for the table T to receive a new supply of ink, and by the form of types passing under the elastic rollers, S, the letters become inked in a very perfect and uniform manner. Whilst the operation of inking the types is going on at one end of the machine, the printing is performed at the other end on one of the sides of the sheet from the types last inked, and *vice versa.* The type carriage is caused to move steadily along with the circumferences of the cylinders F and G, by having racks, *y y*, formed on each side of the forms of types (as seen in fig. 2,) which engage with sectors, or portions of toothed wheels, *x x*, upon the ends of the said cylinders ; at which part the surfaces of the cylinders are covered with a blanket or felt, to give elasticity, and cause them to press equally upon the paper as in ordinary printing presses.

The machine is put in motion by a strap, *y y*, passing round a pulley, X, as seen in fig. 1, upon the axis of which a pulley or pinion is fixed, engaging with the teeth of the large wheel upon the end of the main cylinder G. Thus the various cylinders, with their two systems of tapes, are caused to revolve with a uniform movement in the direction of the arrows (seen in fig. 2,) whilst the type carriage travels alternately backwards and forwards upon its guides as before mentioned.

The operation of printing is performed as follows : The sheets of blank paper are laid one by one upon the table B, so as to bear upon the linen tapes which extend over its surface. In this situation, the rollers C and D are caused to move a portion of a revolution, by the operation of a lever, fixed upon the axis of the roller D, being acted upon by another lever fixed on the cog wheel of the main cylinder F. This motion advances the sheet of paper sufficiently to enable it to be seized between the two systems of endless tapes at the point where they meet each other, or between the rollers *h* and E. As soon as the sheet of paper is carried clear off the table B, the rollers C and D are caused to turn back again to their original position, by the operation of a weight, W, and a cord, *w*, as seen in fig. 2, ready to advance a second sheet of blank paper into the machine. The sheet of paper is carried along between the system of tapes, and applies itself to the circumference of the main cylinder, F, upon the blanket before mentioned; and by the continuous motion of the cylinder, the sheet of paper is pressed upon the surface of the form of types as it passes under the cylinder by the reciprocating motion of the carriage.—By this means, one of the sides of the sheet receives its impression at the same time that the form of types situated at the opposite end of the carriage is receiving the ink as before described. Now, by the continuous motion of the machine, the sheet of paper advances in company with the endless tapes, round the intermediate cylinders, H and I, until it applies itself to the blanket upon the surface of the main cylinder G ; at which place it will be found in an inverted position, so that the printed side of the sheet is in contact with the blanket, and the blank side of the sheet downwards, which upon meeting with the other form of types at the proper instant, is pressed upon their surface sufficiently to produce the impression. Thus having arrived at the point where the two systems of tapes separate, the printed sheet is delivered upon the board Z, where it is received by a boy and laid upon the pile.

On Calculating by Machinery—Mr. Babbage's Plan. [From Partington's British Cyclopædia.]

The great Pascal was the first who succeeded in reducing to pure mechanism the performance of a variety of arithmetical operations, and a description of the instrument by which he effected this object is to be found in the fourth volume of the *Machine Approuvees* of M. Gallon. In 1673, Sir Samuel Morland published an account of two different machines which he had invented, one for the performance of addition and subtraction, and the other for that of multiplication, without however developing their internal construction. About the same period the celebrated Leibnitz, the Marquis Poleni, and M. Leupold, directed their attention to the subject, and invented instruments for accomplishing the same purpose by different methods. Leibnitz published his plan in the *Miscellanea Berolensia* of the year 1709, giving, however, only the exterior of the machine ; and Poleni communicated an account of his to the same work, but also explained its internal construction. Both of these machines, together with that of Leupold, were subsequently described in the *Theatrum Arithmetico-Geometricum* of the latter, published at Leipsic in 1727. We must not omit to mention the *Abaque Rhabdologique* of M. Perrault, inserted in the first volume of the work which we have referred to above, the *Machines Approuvees*, by the Paris Academy, which contains also an account of a *Machine Arithmetique* of M. Les-

pine, and of three distinct ones of M. Hillerin de Boistissandeau. In 1735, Professor Gersten, of Giessen, communicated to the Royal Society of London a very detailed description of an instrument of this nature which he had invented, and the hint of which, he says, "I took from that of M. de Leibnitz, which put me upon thinking how the inward structure might be contrived." * *

Notwithstanding the skill and contrivance bestowed upon instruments of a nature similar to that we have just described, their power is necessarily but very limited, and they bear no comparison either in ingenuity or magnitude to the grand design conceived, and nearly executed, by Mr. Babbage. Their very highest functions were but to perform the operations of common arithmetic; Mr. Babbage's engine, it is true, can perform these operations; it can also extract the roots of numbers, and approximate to the roots of equations, and even to their impossible roots; but this is not its object. Its function, in contradistinction to that of all other contrivances for calculating, is to embody in machinery the method of differences, which has never before been done; and the effects which it is capable of producing, and the works which, in the course of a few years, we expect to see it execute, will place it at an infinite distance from all other efforts of mechanical genius. Great as the power of mechanism is known to be, yet we venture to say, that many of the most intelligent of our readers will scarcely admit it to be possible, that astronomical and navigation tables can be accurately computed by machinery; that the machine can itself correct the errors which it may commit; and that the results, when absolutely free from error, can be printed off without the aid of human hands, or the operation of human intelligence. "All this, however," says Sir David Brewster, in his entertaining *Letters on Natural Magic*, "Mr. Babbage's machine can do; and, as I have had the advantage of seeing it actually calculate, and of studying its construction with Mr. Babbage himself, I am able to make this statement on personal observation." It consists essentially of two parts, a calculating and a printing part, both of which are necessary to the fulfilment of the inventor's views, for the whole advantage would be lost if the computations made by the machine were copied by human hands and transferred to types by the common process. The greater part of the calculating machinery, of which the drawings alone cover upwards of 400 square feet of surface, is already constructed, and exhibits workmanship of such extraordinary skill and beauty, that nothing approaching to it has hitherto been witnessed. In the printing part, less progress has been made in the actual execution, in consequence of the difficulty of its contrivance not for transferring the computations from the calculating part to the copper, or other plate destined to receive them, but for giving to the plate itself that number and variety of movements which the forms adopted in printed tables may call for in practice.

The practical object of the calculating engine is to compute and print a great variety and extent of astronomical and navigation tables, which could not otherwise be done without enormous intellectual and manual labor, and which, even if executed by such labor, could not be calculated with the requisite accuracy. Mathematicians, astronomers, and navigators, do not require to be informed of the real value of such tables; but it may be proper to state, for the information of others, that *seventeen* large folio volumes of logarithmic tables alone were calculated under the superintendence of M. Prony, at an enormous expense to the French government; and that the British government regarded these tables to be of such national value, that they proposed to the French Board of Longitude, to print an *abridgment* of them at the joint expense of the two nations, and offered to advance £5000 for that purpose. But, besides logarithmic tables, Mr. Babbage's machine will calculate tables of the powers and products of numbers, and all astronomical tables for determining the positions of the sun, moon, and planets; and the same mechanical principles have enabled him to integrate innumerable equations of finite differences—that is, when the equation of differences is given, he can, by setting an engine, produce at the end of a given time any distant term which may be required, or any succession of terms commencing at a distant point.

On the means of accomplishing this, we need make no apology for quoting Mr. Babbage's own words. "As the possibility of performing arithmetical calculations by machinery may appear to non-mathematical readers too large a postulate, and as it is connected with the subject of the division of labor, I shall here endeavor, in a few lines, to give some slight perception of the manner in which this can be done; and thus to remove a small portion of the veil which covers that apparent mystery. That nearly all tables of numbers which follow any law, however complicated,

may be formed, to a greater or less extent, solely by the proper arrangement of the successive addition and subtraction of numbers befitting each table, is a general principle, which can be demonstrated to those only who are well acquainted with mathematics; but the mind, even of the reader who is but very slightly acquainted with that science, will readily conceive that it is not impossible, by attending to the following example. Let us consider the subjoined table. This table is the beginning of one in very extensive use, which has been printed and reprinted very frequently in many countries, and is called a table of square numbers.

Terms of the Table.	A. Table of squares.	B. First Difference.	C. Second Difference.
1	1		
		3	2
2	4		
		5	
3	9		2
		7	
4	16		2
		9	
5	25		2
		11	
6	36		2
		13	
7	49		

Any number in the table, column A, may be obtained by multiplying the number which expresses the distance of that term from the commencement of the table by itself; thus 25 is the fifth term from the beginning of the table, and 5 multiplied by itself, or by 5, is equal to 25. Let us now subtract each term of this table from the next succeeding term, and place the results in another column (B), which may be called first-difference column. If we again subtract each term of this first-difference from the succeeding term, we find the result is always the number 2 (column C); and that the same number will always recur in that column, which may be called the second-difference, will appear to any person who takes the trouble to carry on the table a few terms further. Now, when once this is admitted as a known fact, it is quite clear that, provided the first term (1) of the table, the first term (3) of the first-difference, and the first term (2) of the second or constant difference, are originally given, we can continue the table to any extent, merely by simple addition: for the series of first-differences may be formed by repeatedly adding the constant difference 2 to (3) the first number in column B, and we then necessarily have the series of odd numbers, 3, 5, 7, &c.; and again, by successively adding each of these to the first number (1) of the table, we produce the square numbers."

Having thus thrown some light on the theoretical part of the question, Mr. Babbage proceeds to shew that the mechanical execution of such an engine as would produce this series of numbers is not so far removed from that of ordinary machinery as might be conceived. He imagines 3 clocks to be placed on a table, side by side, each having only one hand, and a thousand divisions instead of twelve hours marked on the face; and every time a string is pulled, each strikes on a bell the numbers of the divisions to which the hand points. Let it be supposed that two of the clocks, for the sake of distinction called B and C, have some mechanism by which the clock C advances the hand of the clock B one division for each stroke it makes on its own bell; and let the clock B by a similar contrivance advance the hand of the clock A one division for each stroke it makes on its own bell. Having set the hand of the clock A to the division I, that of B to III, and that of C to II, pull the string of clock A, which will strike one; pull that of clock B, which will strike three, and at the same time, in consequence of the mechanism we have referred to above, will advance the hand of A three divisions. Pull the string of C, which will strike two and advance the hand of B two divisions, or to Division V. Let this operation be repeated: A will then strike four; B will strike five, and in so doing will advance the hand of A five divisions; and C will again strike two, at the same time advancing the hand of B two divisions. Again pull A, and it will strike nine; B will strike seven, and C two. If now those divisions struck, or pointed at by the clock A, be attended to and written down, it will be found that they produce a series of the squares of the natural numbers; and this will be the more evident, if the operation be continued further than we have carried it. Such a series could of course be extended by this mechanism only so far as the three first figures; but this may be sufficient to give some idea of the construction, and was in fact, Mr. Babbage states, the point to which the first model of his calculating engine was directed.

In order to convey some idea of the power

of this stupendous machine, we may mention the effects produced by a small trial engine constructed by the inventor, and by which he computed the following table from the formula x^2+x+41. The figures, as they were calculated by the machine, were not exhibited to the eye as in sliding-rules and similar instruments, but were actually presented to it on two opposite sides of the machine, the number 383, for example, appearing in figures before the person employed in copying. The following table was calculated by the engine referred to:

41	131	383	797	1373
43	151	421	853	1447
47	173	461	911	1523
53	197	583	971	1601
61	223	547	1033	1681
71	251	593	1097	1763
83	281	641	1163	1847
97	313	691	1231	1933
113	347	743	1301	2021

While the machine was occupied in calculating this table, a friend of the inventor undertook to write down the numbers as they appeared. In consequence of the copyist writing quickly, he rather more than kept pace with the engine at first, but, as soon as five figures appeared, the machine was at least equal in speed to the writer. At another trial, thirty-two numbers of the same table were calculated in the space of two minutes and thirty seconds, and as these contained eighty-two figures, the engine produced thirty-three figures every minute, or more than one figure in every two seconds. On a subsequent occasion, it produced 44 figures per minute; and this rate of computation could be maintained for any length of time.

It may be proper to add, that Mr. Babbage stated to the editor of this work, that he considered the powers of his machine as scarcely at all developed—indeed, that the automaton was yet but in its infancy. If such be the childhood of this gigantic engine, what may we not expect from its maturity? There is a general belief that this gentleman has received a large parliamentary grant as a reward for his invention; this is, however, a vulgar error. He has superintended the construction of the instrument at the expense of the Government, but he has not directly or indirectly received the slightest pecuniary compensation for his services.

Education universally extended throughout the community will tend to disabuse the working class of people, in respect of a notion that has crept into the minds of our mechanics, and is gradually prevailing, that manual labor is the only source to wealth. James Watt and Robert Fulton were worth more to society than five hundred thousand hedgers and ditchers.—[Cooper on Political Economy.]

The Mechanical Arts.—Next to Agriculture, in point of necessity and usefulness, should be regarded the arts of mechanism. Who is more deservedly entitled to our respect and a rich pecuniary reward, than he who can so control the properties of motion, and calculate velocities so as at once almost to annihilate time and space? than he who is enabled, by the force of the elements themselves, to convert all, that is within reach in nature, to the most advantageous purposes—either to assist man in his enterprises, by supplying his weakness, or to satisfy his wants, or contribute to his convenience?

While our country abounds in the variety of materials necessary to be wrought by the ingenious mechanic into labor-saving machines, and while this supply of materials affords him, of ever so humble means, the required facilities of accomplishing the most surprising works within the compass of human agency, it offers, also, a stimulus to the capitalist to encourage the highest degree of perfection in machinery, for the economy of labor, of which the modifications of the mechanic powers are susceptible.

The vast extent of our territory; its cheap and luxuriant soil, inviting by the salubrity and variety of its climate, to all who may choose the honorable calling of husbandry, with a sure promise of a rich reward, renders nugatory the objections of some, that human labor will be out of demand. In this government, at least, while the best of wild lands, at a nominal price, are accessible to all, industrious and ingenious mechanics will never go unrewarded because machinery is too plenty. —And no other country offers the same reciprocal assurance of success in the cardinal pursuits of human industry; the field of our agriculture has no known limits; our commerce, resting on the industry and enterprise of a republican people, looks boldly to countries the most remote; while the motto over the entrance of our manufactories is "Onward." Already may it be truly said of the American Mechanist, as it was by the Grecian—Give him but a fulcrum and he will move the world.

With the ardent mechanist, a thorough knowledge of mechanical laws, and a power of referring effects to causes, and vice versa,

which always depend upon and lend to each other reciprocal aid, is the basis of improvement and discoveries; and a judicious adaptation of materials, and a scientific combination of forces, constitute the perfection of his art.—[Syracuse Argus.]

Locomotion without Steam.—On the 23d of last month, Mr. Hoffman, an engineer of Dantzic, made a first experiment with his newly invented machinery for driving paddle wheels without the application of steam.—Several friends accompanied him in his trip, which his little vessel performed to admiration, though at a somewhat slow rate. We are told that the mechanism, by which the wheels are impelled derives its power from quicksilver instead of steam.—[Morning Herald.]

Taylor's Patent Improvements in the manner of hanging and effectually securing the Rudders of Vessels. [Communicated by the Inventor for the Mechanics' Magazine.]

These improvements in the manner of hanging and effectually securing the rudders of vessels render their rising and unshipping impracticable, and less liable to injury, and to be used with much less physical power on the wheel or tiller. Their superabundant weight is materially diminished, and rendered more effective for their easy and proper action. These improvements combine a powerful principle of union in their scientific simplicity of construction, and great utility, strength, and durability, in their practical operation: all which are of paramount importance for the proper government and safety of navigable vessels. These improvements are illustrated by reference to the respective sketches and figures, and the following is a description of their construction and application, viz:

Fig. 1.

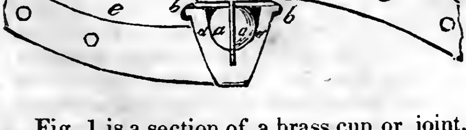


Fig. 1 is a section of a brass cup or joint, in which is formed a hemispherical socket, in working order. The following is a description of its parts, viz:—*a a*, a spherical bearing, in the centre of which is a groove for oil; *b b*, the recess, which contains a leather collar; *d d*, the hemispherical cavity, which contains the spherical bearing, (*a a*,) and also the fluid necessary to lubricate its surfaces, and thereby prevent friction; *c*, shows the groove, formed in the spherical bearing, which permits the fluid to flow up, and lubricates its surfaces every time the ball is moved; *d*, shows the groove, formed in the upper joint for the reception of the lubricating fluid; *e e*, elliptical straps.

Fig. 2. Fig. 3.

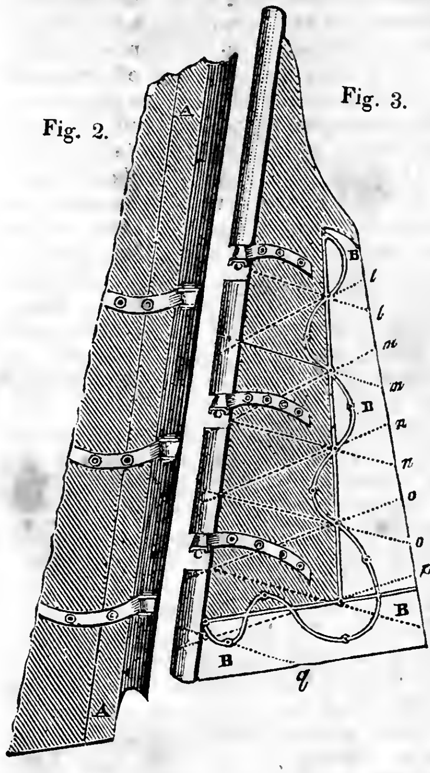


Fig. 2 is part of the stern post, upon which is formed a groove (to match the projection on the rudder), and upon this figure are the lower joints or cups, with their hemispherical sockets and connecting straps, firmly secured to their stations. A A, represent strips of copper, secured to these parts, to give extra strength to the hollow groove, near the angles.

Fig. 3 is the rudder, with its projection (to fit the groove in the sternpost), and attached to which are the upper joints with their spherical bearings; when these balls are let into their stations, (see fig. 4,) this projection will fill the groove in the sternpost, and a hinge will thus be formed for the rudder to play or turn upon, of the *strongest*, *easiest*, and *mo*

durable kind. From the accuracy of the bearing surfaces they will perform their action with peculiar *facility*, and as the upper and lower joints are so correctly fitted together they will exclude the entrance of water, or other substance liable to injure or obstruct them. The projection of the rudder entering the corresponding cavity in the stern post will preserve an even surface with the sides of the stern post, reduce the passage and pressure of water acting on the inner surfaces, and lessen the exposure of the rudder from a blow upon this part. In this manner the rudder will be hung upon the most effective and powerful principle of all joints or hinges, and in the nearest possible position with the stern-post; and by giving the straps (attached to these hanging joints) an *elliptical curve*, with circular projections thereon, to increase the diameter and strength of the screw, or bolt heads, (and likewise the straps,) they are held together in the *strongest* and *most substantial manner*, and the rudder is, when thus hung, perfectly secured against a separation from the vessel, except by being unshipped, or raised out of the joints or hinges, to prevent which an effectual remedy is applied. The circular projections on the straps are hollowed out, to admit suitable screw heads of the same diameter, by which means the joints can be more easily stationed and fitted with *accuracy*, in their centrical positions, than by inserting *bolts*, and striking them to form rivets, which has a tendency, by the *vibration* of blows, to throw the joints out of their proper position. The dotted lines marked *l*, *m*, *n*, *o*, *p*, *q*, represent the *diagonal* direction in which the main bolts are to be driven, both in the rudder and stern post, (in lieu of horizontal,) which will give additional strength to the timbers. Within that part of the rudder post where the lever is let in, (as represented in Fig. 5,) a small circular groove is formed, and a brass tube is to be affixed in this cavity, to act as a channel to convey oil to the first hanging joint, to lubricate the bearing surfaces, and prevent friction. In lieu of oil being applied to the second and third hanging joints, a lubricating composition is to be inserted in the cups, through a tube, previous to hanging the rudder; this composition being heavier than water, a portion will remain in the cups after the rudder is shipped, and will diffuse itself to the bearing surfaces, and throw off friction. The introducing this lubricating composition in lieu of oil is in consequence of these hanging joints being constantly under water, and therefore precluding the insertion of oil to the cavities assigned for that fluid. The bearing surfaces of the hanging joints are not exposed to the violent and irregular action of the water, which would, in some degree, impede their motion, and create additional physical power to guide the helm; neither are they liable to the corrosive operations of rust, or other injurious causes, which now arise from the present mode of hanging ships' rudders.

On that part of the rudder marked B B B, is formed a projection, to receive a corresponding groove, formed in a wing of *cork*, to be attached and secured to it.

From the *elastic* and *buoyant* properties of cork, it will not only create the *first impetus*, or *spring*, to facilitate the action of the rudder, but will operate something like the tail of a fish, in governing the motion of its body,—will also reduce the superabundant weight of the rudder, and render it more easy and natural to perform its working operation. Another wing of cork is secured to the bottom part of the rudder, to act as already described, and to operate as a repulsive power, to preserve the rudder from injury, by the concussion of a blow that may strike this elastic substance.

The serpentine figure, with bars running through the centre of the rudder, is called the *guard*, which, secured on each side of the wings of cork and the rudder, gives *additional strength* and *security* to the rudder, and will preserve its hanging appendages from accident, as well as operate as a *repulsive* power to prevent injury.

Fig. 4.

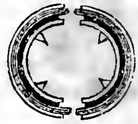


Fig. 4 shows two sections of semi-circular brass clasps, to which are attached two of iron, to be affixed to the bottom part of the rudder post on deck. Within the semi-circular brass clasps are formed a groove to match the semi-circular iron clasps, on which is a projection, and when these figures are stationed and secured together, their surfaces will operate in mutual concert, something similar to a hinge, and act in conjunction with the rotatory motion of the rudder. It will also form a *rest*, *bearing*, and *guide*, for the upper part of the rudder. From which arrangement the following benefits will result: First,

it will materially *sustain the weight* of the rudder, and *relieve* the joints or hinges of their *burthen.* Second, it will effectually *prevent* the rudder from *rising* and *unshipping.* Third, it will form a *bearing* near the tiller, which communicates the motion, and keep it *steady,* and (in conjunction with the ease of the joints or hinges, and other important advantages) will *greatly lessen* the *power* and *labor* of its motion, so that the steersman's toil will be greatly reduced, and he can guide the helm to the respective points of the compass with great *facility and ease,* and thus steer the vessel *accurately* in its course. Two small circular cavities are formed in the two brass semi-circles, affixed to the rudder post, to admit oil, to lubricate the bearing surfaces, and prevent friction, this fluid will run into the grooves formed in the bearings of the brass and iron semi-circular clasps, and diffuse itself to the parts in contact.

Fig. 5.

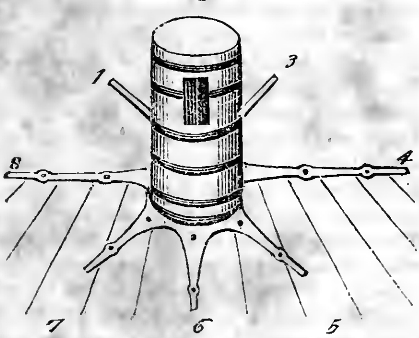


Fig. 5 is a perspective view of the parts complete, affixed to the rudder post on deck, which is secured by elliptical straps, three of which, marked 1, 2, 3, are to be a little elevated, and secured to the stern post and timbers adjoining. Those marked 4, 5, 6, 7, 8, to be secured by being let into the floor of the deck with screws. On the post is represented circular iron binders, and mortice for the lever.

Mr. Torrey's Patent Safety-Apparatus for preventing the Explosion of Steam Boilers. Communicated by the Inventor for the Mechanics' Magazine and Register of Inventions and Improvements.

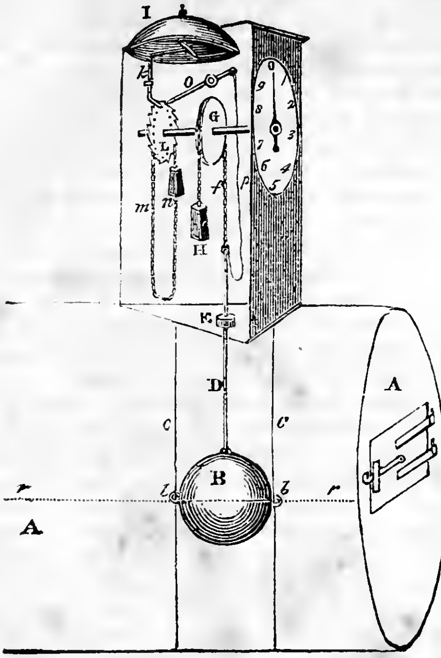
In consequence of the great destruction, both of lives and property, occasioned by the explosion of steam boilers, and the collapsing of their flues, it has been a subject of universal inquiry to find some method through the operation of which these disasters may be obviated; and that public excitement has become so excessive in the United States that the Executive of our General Government has issued a request to all scientific persons conversant with the subject, to send to the Secretary of the Treasury such information, or suggestions, as they may deem serviceable to explain the causes of these disasters, and the probable mode of preventing them. From all that can be gathered through the best of sources, and from engineers themselves, it is fully admitted that if the following requisites are strictly adhered to, there need be no apprehension of danger, either to life or property, from the operations of steam boilers :

First, Ascertain by experiment the pressure of steam which a boiler and its flues can safely sustain ;

Second, Graduate the safety-valve so as always to be sufficiently within the *maximum* pressure of the boiler and its flues.

These precautions, faithfully attended to, will render steam as safe a power as any other now in use. The third and last precaution is, to keep the boiler at all times *sound,* when in use. Generally, from the diminutive circumference of the flues, when compared with that of the boiler, they can sustain more pressure from the steam acting on their outside, than the boiler within which they are placed can withstand inside ; yet it is found that there have been more flues collapsed in boilers than there have been boilers exploded. Why should this be? The answer is, the metal of the flues must, from some cause, have sustained an injury. How can this injury accrue? The only reason apparent to the mind is, that the tops of the flues were left uncovered by the water ; thereby permitting the heat within them to burn and weaken the metal of which they were composed—consequently, the want of a sufficiency of water in a boiler, whether with or without a flue, or flues, is the cause of a collapse. The same argument will apply to the boiler itself, provided the fire applied outside rises higher than the water within ; therefore, agreeably to this reasoning, it must be inferred that if a boiler be proved strong enough to sustain a certain pressure, and the safety-valve is sufficiently loaded within that force, that the only cause why a boiler should explode, or a flue collapse, is from the want of a due quantity of water in the boiler. An engineer cannot tell the precise height of the water by the guage cocks, even should he be trying them all the while ; for water will fly up when the cock is open, although above the water's level.

Viewing the importance of the foregoing considerations, and the darkness now surrounding the subject, the following apparatus has been made and applied successfully to a steam boiler in a steamboat:



REFERENCES.—A A, a cylindrical boiler, and *r r*, the water line inside of it; B, a globular float, intended to move perpendicularly —for which purpose it has two or more rings, *b b*, affixed to it, through which the rods *c c* pass, being made fast at their ends at the top and bottom of the boiler; D, a straight rod, or piston, the lower end of which is attached to the float B, and the upper, after passing through the stuffing box, E, on the top of the boiler, is fastened to one end of the chain *f*, which passes over the wheel G—on the other end is hung the weight H; I, is an alarm bell, and *k*, the tongue or hammer which rings the alarm; L, a wheel which communicates with the hammer *k*, and over which the chain *m* is placed, to which the weight *n* is hung; O, a ketch communicating with the top of the rod D, by the cord *p*.

Of the fact that this apparatus will give the true height of the water in any boiler, and thereby give sure warning of impending danger to the lives and property of all near about, whether on board of the boat, or elsewhere, there is no doubt; but this is not the only advantage resulting from the application of it, which the following remarks will amply demonstrate.

In order to generate the *maximum* of steam from a definite quantity of fuel, there is one thing to be observed—which is, the principle regulating the power. *Ice* and *caloric* are the material of steam. Ice is the mere body *acted on*; caloric is the *operator*. This great mover must be dealt with in an economical manner, for the expense of water is but trifling, and fuel is high. To instance a component of steam: it forms at the bottom of the boiler in the shape of a bubble—now, in order to produce this bubble, a certain quantity of caloric is received, *more* than is requisite to raise the temperature to 112 degrees Fahrenheit, which super-abundant heat is termed *latent*. This bubble rises through the water, which, in temperature, is below the evaporable point, at the ordinary pressure of the atmosphere; and in its ascent, from the difference of its and its surrounding water's temperature, loses more or less of the super-abundant heat of which it is possessed. Should it have to pass too far through this element, it would lose all of this super-abundance of caloric, and become a part of the water itself; hence, the shorter distance a bubble has to ascend through the water, the less liable it is to lose its character of steam. The history of one bubble will answer for the whole that causes the operations of a steam engine. The question may be asked, where does this extra or latent caloric go, when the bubble liquidates? The atmosphere passing around the sides of the boiler will answer for the fact.

Granting every thing in readiness, and the height of the water in the boiler at the level *r r*, it is evident that if the water falls the float must fall likewise, (always supposing the friction to be not too great for the weight or buoyancy of the float to overcome,) drawing the weight H up, and turning the wheel G, which moves the hand on the dial plate, which, by its figures, denotes the rise or fall of the float B, and the rods *c c* oblige it to move perpendicularly. The alarm can be given at any height of water for which it may be set, for the cord *p*, when tightened, loosens the ketch *o*, and the cord *p*, as it falls, stretches that cord; therefore, when the water has descended so far as to be considered dangerous, and the time of alarm is set at that point, the ketch *o* is sprung; the wheel L, then being at liberty to turn, is caused to revolve by the fall of the weight *n*, hung to the chain *m*, and this turning

of the wheel L vibrates the tongue or hammer *k*, and the alarm is given. When the water rises, the float will necessarily raise with it, and the distance be denoted by the figures 1, 2, 3, &c. on the dial plate. A spring, or rack and pinion, can be substituted for the weight H, should either be preferred.

[Of the utility of Mr. Torrey's invention there cannot exist a doubt in the mind of any reasonable person. Most of the accidents that have occurred in steamboats have been occasioned by the bursting of the boilers, and to find an effectual remedy for preventing a recurrence of similar disasters, has engaged the attention of practical and scientific men for a series of years. Mr. Torrey's plan, it appears to us, is an effectual one—it is so simple that it is almost incredible that it has hitherto escaped the notice of those whose avocations must bring the subject daily and hourly under their immediate notice. —The invention has been deemed of sufficient importance by several gentlemen to form a joint stock company for carrying into effectual operation the plan. The apparatus as above described has been placed by them on the *Delaware*, steamboat, plying between this city and Providence, and experiments have been made in the river, that leaves no doubt of the complete success of the undertaking. In a few days she will make her first trip, and we trust that in our next we shall be enabled to give a satisfactory account of its practical operation.—Ed. M. M.]

Experiments in Canal Steam Navigation. By R. G. M. [From the London Mechanics' Magazine.]

Mr. Editor,—It may be deemed very imprudent for an individual with small means to attempt propelling a canal boat by steam, especially when there are many persons in his neighborhood more competent to the undertaking, having more money and better conveniences for the purpose. I well knew, however, that though their means and appliances were ample, they had more lucrative and agreeable channels wherein to apply both. With this impression on my mind, and having no employment for a small steam engine which I had by me, I commenced the experiment which I beg now to relate.

Selecting an old heavy-sailing canal boat, I tried several kinds of paddles placed in various situations of the boat, repeatedly altered the machinery, and travelled several voyages with her myself, the last of which was about five miles in three hours on the Birmingham canal, with twenty tons long weight on board her, exclusive of the machinery. With this heavy-sailing old canal boat, an engine, not built for the purpose, and machinery put together in a country place, where no such workmen or tools can be had as are to be found in large manufacturing towns,—with these disadvantages I have performed that voyage by steam alone, without the aid of any other power. By this dearly bought experience, I am in possession of the dimensions and capacity of every article necessary—the limits of the projection of the machinery and guards, above, below, and on the sides of the vessel, so as to clear locks, bridges, slopes, and other boats and lines, with the precise strength of the engine required to propel a boat at the utmost speed which the depth of canal will admit. I can, therefore, confidently state *that canal boats can be propelled by steam* to answer every purpose, except short voyages and frequent loading, up and down any locks, without injury to the canal banks, without injury to other craft, with the same manual labor, and with about five shillings in fuel for a hundred miles' voyage. The charge of steam navigation being injurious to the canal banks must have originated in error, or perhaps from prejudice, before the railroad system had been proved: for my own part, if I wanted to lessen the damage now done to the canal banks and other boats, I would propel them by steam instead of tracking by horses. In fact, any person acquainted with the business of a canal will acknowledge that a horse draws in an indirect line, while the steerer to keep his vessel straight, puts the helm to the opposite side, which causes a heavy surge, and this is much increased in windy weather, and with an increased speed still more; while a steamboat glides sweetly and majestically through the water, the paddles heaving in a direct line always ahead. With regard to speed, it must be in proportion to the shape of the boat, the quantity of lading on board, and the depth of water; and, generally speaking, the depth of canals is not such as to admit of a very great rate of speed, because, if a power sufficient were applied to a boat heavily laden, she would soon drag on the bottom. But it must be remembered, that if a horse draws a boat at the rate of seven miles an hour, that boat and horse, at the end of an hundred miles voyage, would be more than 20 miles behind one propelled by steam at

the same rate, since passing the lines of other boats, and thus letting down the boat's momentum, would cause this difference.

At some cost, and much labor, I have enabled myself to state these facts, but at present I must lay my boat and engine aside, from necessity, however, not choice. If there be any thing in my experience acceptable to a more competent adventurer than myself in so laudable an undertaking (for it wants only competence), so as not to leave it in the hands of monopoly, I would gladly afford every information in my power.

December 13, 1832.

The Chiragon, or Guide for the Hand.—Mr. Wm. Stidolph, a schoolmaster at Blackheath, has invented an apparatus to which the name of Chiragon is given; by the assistance of which, a person who has become blind after learning the art of writing, may continue his practice without the risk of confounding words or lines together. It consists of a frame, with a raised margin, upon which margin is placed a narrow piece of wood, having a groove to receive a corresponding key that is attached to a collar or bracelet for the wrist. In the sides of the frame series of notches are cut, into which the grooved piece of wood is placed successively so as to form the regular intervals between the lines, whilst the hand is permitted by the collar to pass freely from the left to the right, but is confined to certain limits in its action up and down, or in the direction of the length of the paper used. The writing is effected with Mordan's patent pencils; and we have proved the efficiency of the invention, by writing a letter with its guidance while our eyes were bandaged so as to exclude the sight of every object.—[Athenæum.]

Monthly Analysis of the Contents of Scientific Periodicals.

The *London Mechanics' Magazine*, for December, contains much valuable matter—some of which we shall insert in our next number. There are no less than six attacks in it on the publications of the "*Society for diffusing Useful Knowledge*," from various correspondents of the work; and added to these the Editor has inserted his remarks, on what he calls the "*one sided treatises on Sciences*," put forth under their sanction. The communication signed Samuel Downing, Cabinet-Maker, on the "education of the working classes," is really excellent; it is couched in eloquent nervous language, and will well repay an attentive perusal.

Mr. Baddeley's letter on Martin's improved Frictionless Pump, for which Mr. Shalders has obtained another patent, is good—as indeed are all communications from the pen of that gentleman. Mr. B. contends that the new patentee can claim no exclusive right to his invention, and in that opinion "Mr. Hebert, the talented Editor of the Register of Patent Inventions," concurs. He observes, "this *new invention* is one of the *oldest* contrivances we ever met with in the specification of a patent. The patentee has, we hope, found it to answer his purpose, and we dare say has felt infinite satisfaction in his discovery; but in *attempting to secure to himself*, by patent right, the exclusive privilege of using the machine, we fear he has *expressed* more money out of his pocket than will ever *gravitate* into it again from the same source."

Another claimant for the merit of making some of the *first British experiments in Steam Navigation*, has come forth in the person of Mr. W. Symington, Jun., (for his father.) Mr. S. states that the "*first public trial of steam for a useful purpose in navigation*" was made by his father on Dalswinton Lake, in Dumfreeshire, in 1788—and repeated on the Clyde in 1789. An engraving of the boat accompanies his letter.

Mr. John Bate, the celebrated Mathematical Instrument Marker, of Cornhill, London, has obtained a patent for what he calls "an improvement, or improvements, on machinery applicable to the imitation of medals, sculpture, and other works of art executed in relief." This in fact is no more nor less than a revival of Mr. Asa Spenser's invention, (of the firm of Draper & Co., Bank Note Engravers,) of Philadelphia. The engravings with an excellent description by Mr. Hebert, from the Register of Arts, we shall give in our next; as also, Mr. Robert Mudie's really Philosophical Treatise on Dry-Rot—which is written in that singular original style which pervades all his writings.

The London Repertory of Patent Inventions, for February,, contains an excellent account of an improvement in the construction of Iron Railways with plates, which we shall publish in our next number.

The rest of the number is mostly made up of accounts of American patents and inventions. Among them is a description of an

alarm to be applied to the interior flues of steam boilers, by Dr. Bache, of Philadelphia. It is very ingenious, but we think Mr. Torrey's invention (described at page 153 of this Magazine) is more simple, and will prove more efficacious.

The Journal of the Franklin Institute, for February, contains the Report of the Franklin Institute for the year ending January 17, with a list of managers and other office bearers. It consists principally of an account of the changes made in their Hall, but leaves the public in ignorance of the total number of members of which the Institute consists. It appears, however, that it is in a prosperous state.

It also contains an excellent report made to the Washington City Lyceum, by the learned editor Dr. Jones, on the question, "*Are there any trades so injurious to health, or so hazardous to morals, that they ought, for that reason, to be discouraged or abandoned?*"

The Doctor enumerates the pernicious effects arising from several employments—among the most striking of them we will select that of the needle pointer:

"Of the persons engaged in the pointing of needles, very few indeed reach the age of forty years, by far the greater number dying under that of thirty-two. The fine particles of steel which are ground off are so light as to float in the air, and are so copiously deposited upon the mouth and nostrils as completely to blacken them; much irritation is produced by them in the lining membrane of the nose, and at first a copious mucous discharge is produced from it; but afterwards, the irritability of the parts is exhausted, and they become perfectly dry. The trachea, or wind-pipe, is next affected; respiration becomes difficult, and an habitual, exhausting cough is produced. Soon, nearly all the animal functions are disturbed, the digestive organs refuse to perform their offices, and, the lungs, in particular, become the main seat of that total derangement of the whole system which must soon terminate in death. To find a man who has followed this trade for twenty years is almost impossible.

"I have introduced the pointing of needles as an example of the deleterious effects of the fine dust of steel, but the like evils are experienced in the making of a great number of other instruments of iron as well as of steel. Forks, for example, are finished by what is called dry grinding; that is, by grinding them upon a stone without water. Numerous utensils, also, of cast iron, when finished on the dry stone, or by fine files, give out a dust producing all the effects which I have described, and in an equal degree. To put a youth to these businesses, therefore, is to bespeak for him an early grave; yet, society wants and must have the articles, and there is no more difficulty in inducing men to follow these trades than there is in enlisting them for the purpose of being killed, *secundum artem*, in the army or the navy; especially if they are to receive a few pence per diem more for this than for some other species of labor."

The concluding remarks will shew the view of the question Dr. Jones has taken:

"In a despotic government, where human life is held cheap, a tyrant may compel an individual to wear an iron mask, without offering a reason why, but in a free government, where the life of every citizen ought to be accounted of inestimable value, the only mode of inducing a man to wear one for his own benefit, as well as to do many other desirable and proper things, is to give to him that degree of education which shall elevate him in his own opinion, and induce him to act from motives more worthy his intellectual nature than those which usually govern persons in walks of life accounted much more exalted than that of the great body of workmen in our manufactories: this is the only remedy upon which I can found any hope; but, were I standing upon the threshold of life, just about to enter upon its duties, and possessing in the commencement of my career the benefit of the few observations which I have made, the little truth I have gleaned in the years which I have numbered, I should even then consider the hope as utopian that I should live to witness the dawn of such a state of things in the humbler walks of life; for, warmly as I now feel in favor of a system of universal education, and great as I believe the benefits which are to be derived from it, I do not entertain a hope that by any effort, merely human, the great body of any community can be so far elevated above the level at which they now stand, as to induce them to act the philosopher in cases of this description. At all events, I am fully of opinion that so far as governments are concerned in the regulation of trades and callings, they ought to be, as they generally have been, confined in their action to the prevention of nuisances; that artisans and manufacturers should be allowed to pursue their own business in their own way; and that *Laninez nous faire*, should be their motto."—[Ed. M. M.]

Fall in the price of Men in France.—Towards the close of the Imperial regime in France as high as £500 sterling ($2200) was, it is stated in the London Spectator, "frequently paid for a substitute in the Conscription. At present, straight, healthy, apt young fellows cost under £10 st. ($44) each."—The reason assigned for this fall in the price of man is, that "such men as have no other property than their *sinews*, are far more numerous than twenty years ago, and wages are reduced in the same proportion." This comes of what Shakspeare expressively calls "the cankers of a calm world and a long peace."

Compensating Pendulums.—Mr. Henry Robert, pupil of Breguet, has, by availing himself of the well known quality possessed by the wood of the fir tree of preserving its length unaltered in all changes of temperature, and confining a rod of this wood in a metal box, the expansion of the bob correcting that of the tube, succeeded perfectly in making a pendulum, uniting all the requisites of a good compensator, and at the same time simple in its construction and form.—[Acad. des Sciences.]

M. Latreille, the celebrated French naturalist, died Feb. 6th at Paris. His death creates a vacancy in the Academy of Sciences, and the professorship at the Museum of Natural History.

Rival Orators.—Mr. Fox used to say, "I never want *a* word, but Pitt never wants *the* word." This story occurs in many memoirs of the time.—[Murray's Byron, vol. 14.]

METEOROLOGICAL RECORD.

MONTREAL, L. C.

Date.	Thermometer.		Barometer.		Weather.
	7 a.m.	3 p m.	7 a.m.	3 p m	
Jan. 1..	38 x	43 x	29.88	30.43	rain—fair
" 2..	10	28	30.68	.62	fair
" 3..	17	31	.41	.33	..
" 4..	35	49	.04	.06	rain—cloudy
" 5..	33	28	.13	29.97	.. — ..
" 6..	37	28	29.84	.82	fair
" 7..	18	15	30.04	30.02	..
" 8..	23	30	29.94	29.98	..
" 9..	25	38	.54	.52	..
" 10..	31	33	.48	.61	..
" 11..	12	4	.89	.96	..
" 12..	3	14	.96	.98	snow—fair
" 13..	21	28	.92	.77	..
" 14..	19	5	.67	.89	.. —fair
" 15..	9	12	.46	30.21	.. — ..
" 16..	20	25	.21	29.47	.. — ..
" 17..	19	2	30.38	30.25	fair
" 18..	14	3	29.95	.30	..
" 19..	25	13	30.76	.45	..
" 20..	23	34	.18	.04	fair—snow
" 21..	32	40	29.79	29.87	..
" 22..	37	30	.87	.16	..
" 23..	27	32	30.[illegible]0	30.17	..
" 24..	23	43	.14	.06	..
" 25..	29	30	29.53	29.31	snow
" [illegible]..	3	11	30.30	30.38	fair
" 27..	0	19	.37	.22	..
" 28..	6	11	.12	.27	..
" 29..	6	14	.36	.18	..
" 30..	10	23	29.84	29.87	snow—fair
" 31..	0	11	.93	30.01	fair

CHARLESTON, S. C.

Date.		Thermometr			Wind.	Weather.
		7 a. m.	2 p. m.	9 p. m.		
January	1	61	66	61	S	cloudy—rainy morning
"	2	58	67	62	NE	..
"	3	57	67	61	E	..
"	4	58	62	61	NE	rain
"	5	53	62	61	..	cloudy—drizzle
"	6	56	73	64	W	fair
"	7	57	70	64	SW	cloudy—rain at night
"	8	54	48	43	NW	..
"	9	46	57	51	SW	fair
"	10	42	42	29	W	cloudy—a little snow
"	11	20	35	31	..	..
"	12	30	32	42	..	fair
"	13	38	48	48	S	cloudy—rain at night
"	14	48	58	49	W	cloudy—drizzle
"	15	49	59	59	E	..
"	16	58	60	52	SW	.. —rain in morning
"	17	38	42	37	N	..
"	18	30	52	42	..	fair
"	19	38	48	45	NE	..
"	20	42	47	50	..	..
"	21	44	68	54	S	..
"	22	52	64	55	..	..
"	23	50	61	56	..	..
"	24	53	56	51	N	cloudy—drizzle
"	25	46	56	48	W	.. — ..
"	26	38	48	43	E	fair
"	27	40	58	46	S	..
"	28	44	60	47	E	..
"	29	52	60	56	..	cloudy—rain
"	30	62	61	58	S	rain—hazy rain at night
"	31	56	64	60	SW	cloudy—drizzle at night

AVOYLLE FERRY,

ON RED RIVER, LOUISIANA.

Latitude 31:10 N. longitude 91:59 W, from Greenwich, nearly.
[Communicated for the American Railroad Journal.]

Date.	Thermometr			Wind.	Weather.
1833.	morning	noon	sun set		
Tuesd, Jan. 1	63	67	68	calm	cloudy morn'g—clear ev'g
Wednesday, 2	62	66	66	..	foggy morn.—cloudy all d.
Thursday, 3	63	70	73	south	clear—calm evening
Friday, 4	65	73	74	..	cloudy—clear evening
Saturday, 5	64	68	68	calm	cloudy
Sunday, 6	64	68	67	..	..
Monday, 7	62	57	53	north	.. —very much rain
Tuesday, 8	44	58	54	calm	clear
Wednesday, 9	46	54	48	n. w.	.. —high wind
Thursday, 10	34	50	42	calm	..
Friday, 11	32	52	49	..	..
Saturday, 12	42	59	56	..	cloudy
Sunday, 13	55	65	68	..	clear
Monday, 14	54	60	60	..	cloudy
Tuesday, 15	68	72	68	south	cloudy and rain
Wednsday, 16	51	51	48	north	clear
Thursday, 17	31	47	40	..	..
Friday, 18	30	57	52	calm	..
Saturday, 19	40	62	57	..	..
Sunday, 20	49	64	65	..	..
Monday, 21	54	69	69	..	..
Tuesday, 22	50	61	70	..	foggy morning—clear day
Wednsday, 23	64	67	63	w. & n. w.	clear—severe gale all day
Thursday, 24	42	65	58	calm	clear
Friday, 25	50	58	54	north	..
Saturday, 26	34	61	61	calm	.. —cloudy night
Sunday, 27	46	66	64	..	..
Monday, 28	48	56	60	..	cloudy, and rain all night
Tuesday, 29	61	68	63	south	cloudy, rain and thunder
Wednsday, 30	62	72	66	calm	cloudy in even'g—high w.
Thursday, 31	50	61	59	n. w.	clear [wind

The range of the Thermometer (Fahrenheit's) has been regularly entered in the morning between day break and sun rise, at noon between 12 and 1 p. m, and at night between sun set and dark.

METEOROLOGICAL RECORD, KEPT IN THE CITY OF NEW-YORK.

From the 1st to the 25th day of March, 1833, *inclusive.*

[Communicated for the Mechanics' Magazine and Register of Inventions and Improvements.]

Date.	Hours	Barometer.	Thermometer.	Winds.	Strength of Wind.	Clouds from what direction.	Weather and Remarks.
Friday, Mar. 1	6 a. m.	30.16	20	NE	fresh		snow
	10	.07	20	..	..		..
	2 p. m.	29.99	24	..	..		..
	6	.95	24	..	..		snowy
	10	.90	22	..	moderate		..
Saturday, 2	6 a. m.	.89	20	wsw-wbys-w	..	WNW	fair—scuds from WNW
	10	.84	28	wsw—w by N	st'g-gale	w and WNW	.. —hard snow squalls
	2 p. m.	.98	16	NW	gale	WNW	fair
	6	30.13	11	..	strong	..	..
	10	.23	8	..	..	..	..
Sunday, 3	6 a. m	.28	8	wsw	fresh		..
	10	.26	21	..	..	wsw	.. —cloudy
	2 p. m.	.08	22	sw by w	..	..	cloudy
	6	29.90	22	..	..	..	..
	10	.89	23		moderate	..	..
Monday, 4	6 a. m.	30.04	19	NW—NNW	..—fresh	NW	fair—scuds from NW
	10	.10	22	NW	strong	NW by N	..
	2 p. m.	.18	24	NW by N	fresh	..	..
	6	.27	21	..	moderate		clear
	10	.35	15	..	..		..
Tuesday, 5	6 a. m.	.45	12	NW	light	wsw	fair
	10	.48	21	NW—wsw	moderate	..	.. —thin *cirrus* from wsw
	2 p. m.	.44	23	wsw—sw	..	..	.. —cloudy
	6	.30	21	sw	..	..	cloudy
	10	.19	21	..	..		snowy
Wednesday, 6	6 a. m.	29.89	21	NNE—N	..	w by s	snow—fair
	10	.90	24	NNW	..	wsw / w	fair
	2 p. m.	.97	32	..	fresh	NW	.. —cloudy
	6	30.04	30	..	moderate	..	cloudy—fair
	10	.14	25	..	..	..	fair
Thursday, 7	6 a. m.	.20	24	wsw	light	w	cloudy
	10	.20	29	sw—ssw	moderate	w by s—wsw	..
	2 p. m.	.11	35	ssw—s	..	wsw—sw	.. —clear
	6	.00	34	s	..		clear
	10	29.99	32	..	..	w	fair
Friday, 8	6 a. m.	.94	33	..	..	sw by w	cloudy
	10	.89	38	SSE—variable	light	..	fair
	2 p. m.	.83	42	ESE—E	..	..	cloudy
	6	.78	39	E	..	..	.. —fair—cirrus at wsw
	10	.77	37	ENE	..	..	cloudy
Saturday, 9	6 a. m.	.80	33	N	..	..	fair
	10	.89	42	NNW—w	..	..	..
	2 p. m.	.81	41	WNW—sw	..		clear
	6	.83	40	ssw	..		..
	10	.89	35	..	..		..
Sunday, 10	6 a. m.	30.01	32	sw	..	wsw	fair
	10	.06	44	ENE	faint	..	..
	2 p. m.	.08	45	..	light	w by s	.. —cloudy
	6	.10	40	..	moderate	..	cloudy
	10	.11	38	..	..		rainy
Monday, 11	6 a. m.	.24	30	NNE	..	NNE	cloudy—thick low scuds
	10	.30	34	NE by E	..	NE by E	fair — ..
	2 p. m.	.30	39	NE—ENE	..	NE—ENE	.. — ..
	6	.30	37	E	..	w by s / E	.. —cloudy
	10	.31	36	..	..		cloudy
Tuesday, 12	6 a. m.	.39	36	ENE	..		.. —foggy
	10	.27	33	..	..		.. — ..
	2 p. m.	.18	27	..	..		.. — .. —rainy
	6	.10	37	..	..		rainy— ..
	10	.04	36	NE	fresh		rain
Wednesday, 13	6 a. m.	.00	34	N—NW	..	w by s	cloudy
	10	.10	34	NNW—w	..	..	fair
	2 p. m.	.13	36	NW	strong	NW	.. —scuds from NW
	6	.14	33	..	fresh	..	..
	10	.35	30	..	moderate	..	..

NEW-YORK.

Date.	Hours.	Barometer.	Thermometer.	Winds.	Strength of Wind.	Clouds from what direction.	Weather and Remarks.
Thurs. Mar. 14	6 a. m.	30.45	26	NNW—W	l'nt-calm		clear
	10	.51	36	WSW—SW	calm-l'ht		..
	2 p. m	.52	36	SSW—S—SSW	moderate		..
	6	.38	32	S—SSE	..		..
	10	.39	32	S	..		..
Friday, 15	6 a. m.	.24	34	SSW	..	WSW	cloudy—floating ice continues plenty
	10	.24	37	SW—S by W	light	WSW / NW	.. —fair
	2 p. m.	.24	46	WSW—NW	..—faint		clear
	6	.24	45		calm		..
	10	.29	42		..		
Saturday, 16	6 a. m.	.41	34	NNE	light	NW	fair
	10	.47	44	NE	..	..	..
	2 p. m.	.46	46	NE by E	..		clear
	6	.43	42	NE	..		..
	10	.46	38	..	..		..
Sunday, 17	6 a. m.	.52	30	..—ENE	moderate		..
	10	.56	38	E—ESE	..	E	fair—low scuds from E
	2 p. m.	.51	41	ESE—SSE	..	ESE—SSE	— ..
	6	.48	37	S by E	..	S by E	cloudy— ..
	10	.47	36	..		.	fair— ...
Monday, 18	6 a. m.	.33	36	S by W	faint	SSW	cloudy— ..
	10	.33	38	..	..	..	.. —fair
	2 p. m.	.21	49	S	moderate		clear
	6	.18	43	..	..		..
	10	.19	42	..	light		..
Tuesday, 19	6 a. m.	.15	43	SW	..	WSW	cloudy
	10	.16	47	SSW—S	..	..	fair
	2 p. m.	.12	61	S—SSE	..	..	.. —cloudy
	6	.11	53	SSE	..	..	rainy
	10	.14	50	SE	..—mod.		cloudy—rain
Wednesday, 20	6 a. m.	.13	42	NE by E	moderate		rain
	10	.13	42	NE by E—ESE	—light		..
	2 p. m.	.05	46	ESE—SE	..		foggy and rainy
	6	29.93	48	SE	..		.. ..
	10	.95	46	..	..		.. ..
Thursday, 21	6 a. m.	.83	48	SSE	faint		thick fog
	10	.85	51	..	..	SSE	cloudy and foggy
	2 p. m.	.80	59	S—SSW	moderate	SSW—SW	cloudy—rainy
	6	.69	54	SW	light	SW	cloudy
	10	.65	53	..	..	..	..
Friday, 22	6 a. m.	.69	47	SW—WSW	..	WSW	fair
	10	.71	54	WNW	moderate	WSW / W by N	.. —cloudy
	2 p. m.	.71	55	W—W by S	fr'h-mod.	W by N—NW	cloudy—fair
	6	.74	52	W	moderate	W	fair
	10	.82	47				clear
Saturday, 23	6 a. m.	.99	47	NW—W	faint		..
	10	30.01	54	SSW	light		..
	2 p. m.	.04	56	SSW—S	..		..
	6	29.97	52	S	..		..
	10	.97	44	SSW	..		..
Sunday, 24	6 a. m.	.97	40	..	..		..
	10	.94	50	SSW—SSE	fa't-mod.	WSW / S	fair—small strips of cirri from WSW
	2 p. m.	.87	56	SSE—SE	moderate	.. / ..	hazy—cloudy
	6	.78	46	SE	..	S	cloudy
	10	.75	44	..	light		..
Monday, 25	6 a. m.	.61	42	N	..	S by W / N	..
	10	.62	46	..	..	..	fair
	2 p. m.	.57	57	N by W—NNW	moderate	WNW / NNW	..
	6	.60	53	N by W	light	NNW	..
	10	.70	46				

Average temperature of the week ending March 6th, being the coldest week of the season, 21.14.—Do. of the week ending March 11th, 32.25.—Do. of the week ending March 18th, 36.—Do. of the week ending March 25th, 49.54.

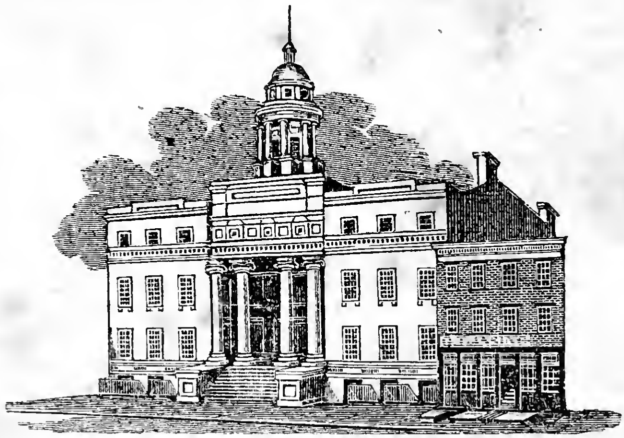
MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME I.] APRIL, 1833. [NUMBER 4.

The caprices of Nature yield us a useful lesson! How inexcusable are those who have neither an ear nor an eye for its constant admonitions,—who suffer the most extensive and the only gratuitous *library of useful knowledge* to remain unread! Shall I venture to call it that splendid annual, published by its Mighty Author for nearly six thousand years, every page of which furnished an inimitable picture of human life, and every line of which presents us an idea and a moral.—FLORA BRUMAL.



MERCHANTS' EXCHANGE, NEW-YORK.

This building is situated on the south-west side of Wall street, on the corner of Hanover street, extending through to Exchange Place, having a front of about 125 feet in Wall street, and forming nearly a square. The basement story is occupied principally by the Post Office. On the principal story is the Exchange Room, which is 100 feet in length and 60 feet in width, with an arched ceiling suspended from the rafters of the building. It is constantly kept well lighted, warmed, and ventilated, and is attended by a person competent to give such information as strangers may require. The other parts of the building comprise the Stock Exchange, and various other offices devoted to mercantile pursuits, which are always in request.

In the dome is the Exchange Telegraph, connected with several stations in the harbor, the most remote of which is on the Highlands of Neversink, in the State of New-Jersey, the distance of which, in *a direct line*, is about 27 miles. This station is situated upwards of 400 feet above the level of the sea, and in clear weather commands a prospect of the offing, upwards of 30 miles in extent. The means of communication by the Telegraph are so easy, that any information can be conveyed through the whole line in less than five minutes.

In addition to the station on Staten Island, the proprietors have placed signal poles, which always show, during the day, the number of inward bound vessels in sight, and they form a guide for pilots, by whom they can be seen from the principal wharves in the city. These stations have been erected at great expense by the Company.

In the Exchange Room is a book, open to the public, in which the Telegraphic communications are entered immediately they are received.

Ballingall's Improvements in Ship-Building.

[From the London Mechanics' Magazine.]

It is now upwards of twenty years since Sir Robert Seppings introduced into the Royal Navy various improvements in ship-building, which are universally allowed to have imparted great additional strength, safety, and durability, to our ships of war: yet, to use the words of Mr. Knowles, (*Inquiry into the Means which have been taken to preserve the British Navy,*) such is "the jealousy incident to human nature, in properly appreciating and applying the inventions of others, or the indolence of the mind in not bringing itself to examine new methods or combinations—these improvements, while they have been eagerly grasped by foreign nations, are but slowly introduced in the ships of our merchants, and, with an apathy hardly to be credited, are totally neglected by the first trading company in Europe (the East India Company)." The advantages of the improved system, however, are so manifest and indisputable, that all that was wanting to bring it into general use, in the mercantile navy, was, that some influential individual connected with shipping should take it up—should make it his business to promote its adoption, not only by his own example, but by pressing it in every possible way on the public attention—should do, in short, for the merchants' yards, what Sir Robert Seppings has done for the King's. We are happy to say that such an individual has at length been found in Mr. Ballingall, the author of a very clever and intelligent work, which we have now before us, entitled "The Mercantile Navy Improved."* Mr. Ballingall has brought to the task he has undertaken, not only all the weight of an official situation of considerable prominence, but great practical experience, combined with what seldom accompanies it in men of his class, a very earnest and clear-sighted desire of improvement. He candidly acknowledges that "the greater part" of the alterations in construction which he proposes to have adopted in merchant ships, are already "in practice in the Royal Navy;" but he has at the same time enhanced the utility of these alterations by so many new suggestions, and added so many valuable contrivances, entirely his own, that he has a fair claim to be considered as himself an improver of the first order.

We cannot undertake to give within the limits to which we must needs confine ourselves, the whole details of Mr. Ballingall's system; but we shall endeavor to place in a distinct point of view before our readers, two or three of its more important features.

1. *The filling in of the timbers*—that is, bringing the ribs or frames into one compact body up to the gunwale—claims, on account of the immense consequences dependent upon it, the first place in our consideration. A ship is but an arch of peculiar adaptation, and the strength of every arch is in proportion to the mutual dependance of the parts on each other; but, according to the ordinary mode of building merchant ships, not more than one-half the timbers have such a mutual dependance. Every alternate couple of ribs only is connected together, and the intermediate timbers (absurdly enough termed *fillings*) are entirely unconnected with each other, resting only on the outer planking, without contributing, in the smallest degree, towards the support of the general structure. This loose and dangerous mode of construction has, at the instance of Sir Robert Seppings, been altogether abandoned in the construction of our ships of war. Every couple of ribs, without exception, is closely connected, and all the smaller interstices, as high as the floor heads, are filled in and caulked; in short, the bottom is converted into one compact solid mass, and that wholly exclusive of the outer planking. It must be evident that a ship thus constructed may sustain very considerable damage in her outer planking—lose actually a plank or two, or even her keel—and yet reach the place of her destination; while the loss of even a portion of a single plank or of the keel would be the destruction of a vessel built on the present mode. When water gets once past the outside planking of any ordinary vessel, nothing but the pumps can save it; and should these get choked, or the crew become exhausted in working them, (both very common cases,) down she must go. From numerous illustrative instances adduced by Mr. Ballingall, of the advantage which ships of war possess over merchant vessels in this respect, we quote the following:

"On or about the same ledge of rocks on which the Wolf, sloop of war, struck, and lay fast for two nights and a day, in March, 1830, at the back of the Isle of Wight, the vessel at the time she struck going at a con-

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* The Mercantile Navy Improved; or a Plan for the Greater Safety of Lives and Property in Steam Vessels, Packets, Smacks, and Yachts, with Explanatory Drawings. By James Ballingall, Manager of the Kirkaldy and London Shipping Company, and Surveyor of Shipping for the Port of Kirkaldy, 1832. Morrison, London.

siderable rate through the water, at the very top of high water of a high spring tide, and with a considerable swell on, and which vessel was got off again and is now in the East Indies, having been dragged over the rocks for half a mile by assistance from Spithead, the vessel beating very hard upon the rocks with the lift of the sea all the time, the Carn Brea Castle, free trader to India, was lost only a few months before, having got ashore under more favorable circumstances for getting off again. What could this be owing to? The ships were nearly, I believe, of similar tonnage. The answer is plain and obvious. The Wolf had a solid bottom of 15 inches thick at the keel, being 12 inches of timbers, and three inches of outside plank, without allowing her to have had any ceiling. The Carn Brea Castle would only have an outside bottom plank to protect her, of, I presume, 3 inches thick. Yet this vessel would have timbers of 12 inches thick, if no more, and a ceiling plank of, I also presume, 3 inches thick, making 3 inches more than the sloop of war, but neither of which were of the least use to her in keeping out the water. Had her timbers been close and her ceiling been caulked, she would have had one more protection than the sloop of war, viz. the ceiling plank, without taking any thing from her stowage, and the fair inference is that she would have been got off and preserved."—P. 97–99.

Mr. Knowles, in a letter to Mr. Ballingall, dated "Navy-Office, October 24, 1831," states that "the whole navy proves that the ships with solid bottoms have been more durable than they used to be when openings were left;" and he particularly specifies the case of the Success, which went ashore in Cockburn Sound, when "the whole keel was carried away, also the lower piece of stern, five feet four inches of the stern-post, four pieces of the dead wood, nine strakes of the bottom, amidships, and many strakes in the bows, and yet this ship was floated off."

Sir Robert Seppings has justly the credit of introducing this practice into general use in the Royal Dock Yards; but when in office, he had himself the liberality to point out to Mr. Ballingall, in the model-room at the Navy-Office, the model of a brig called The Lady Nelson, which was built about 1790, under the directions of Admiral Schanks, on the principle of a perfect union of the timbers, and is now, after a lapse of thirty-two years, still running, and "tight as a bottle."

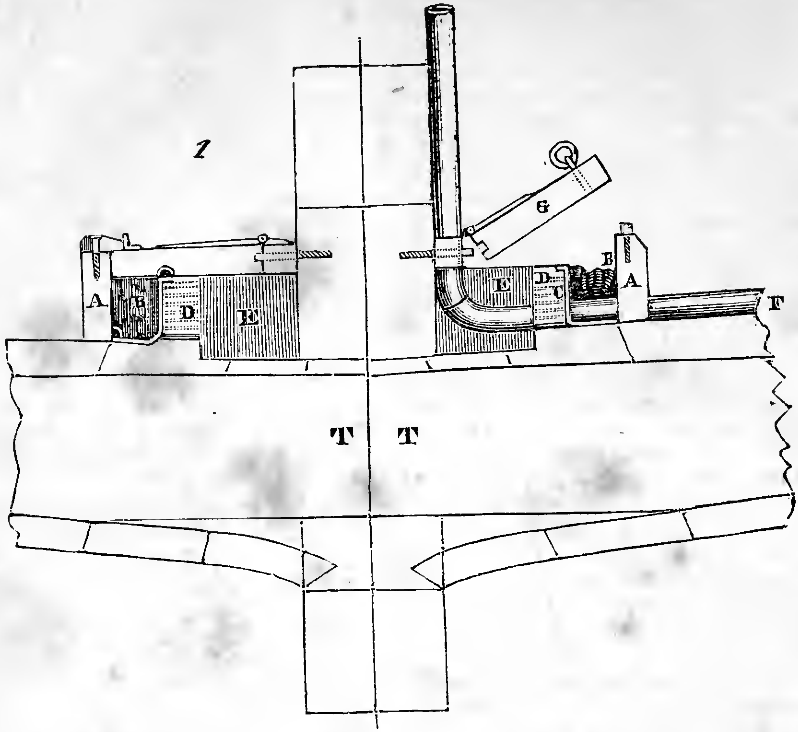
Mr. Ballingall thinks that "nearly all the vessels which have been lost by foundering and collision might have been saved, if the vessels had had solid bottoms;" and there can be no question that the loss of life and property from the neglect of this mode ot construction is annually immense.

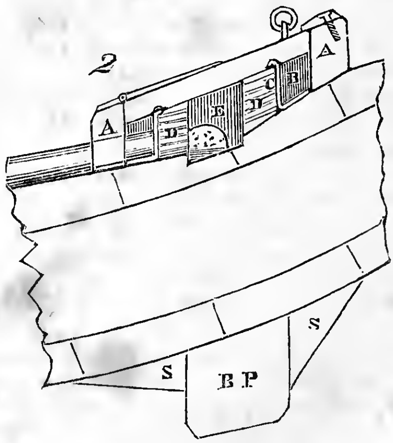
2. *Caulking the whole of the ceiling or inner planking of the vessel*, and thus making it water-tight. This is contrary to the practice pursued in the Royal Navy, and, we are induced to think, somewhat superfluous, but is strongly recommended by Mr. Ballingall, on the ground of its affording a double security against a leak. If this, however, be done, it will be naturally asked how any water, which may have got into the vessel from inboard, is to get to the pumps to be pumped out? The answer to this question brings us to Mr. B.'s third important improvement, which consists in

3. An improvement in the water-courses, by means of what are called percolators:

"I would propose a water-course to be led alongside the kelson on each side, as far forward and aft as may be required from the spring of the vessel raised above the level of the adjoining ceiling, by what I would call percolators, and the bottom of said water-course sunk at least an inch and a half or more below the level of the adjoining ceiling, to allow any water which might get into the vessel to drain off the ceiling into this water-course. There should be a gradual acclivity forward and aft, to cause the water to flow readily along the water-courses to the bottom of the pumps. This would be greatly assisted by the spring of the vessel. In men of war, East and West India ships, and, in general, in all vessels which either carry no cargoes, or their cargoes in packages, these percolators may be readily made of strong and thick oak battens, fastened to the ceiling close to the water-courses, and raised, say from 6 or 8 inches high, above the ceiling, with notches cut in the under edges or sides of them, similar to, I believe, the practice in the navy. These water-courses to be covered with limber boards, as at present, and the boards would not be required to be tight on the top; the boards to be sloped up to the kelson."—P. 20.

Mr. Ballingall does not propose these percolators simply because they obviate the objection before stated to the caulking of the ceiling, but for this further reason, that, whether the ceiling is caulked or not, they furnish a better means of conveying the water to the pumps, and keeping the pumps clear





than any now in use, while at the same time they contribute considerable additional stability to the vessel. The explanations on this head are too long for quotation, but are to our minds entirely satisfactory.

The better to elucidate these different improvements, we copy from Mr. Ballingall's book the accompanying illustrative sketches. Fig. 1 is part of a transverse section of a ship built on Mr. Ballingall's plan, and fig. 2 a continuation of that section (part broken off.) TT is the compact floor, with its bottom and ceiling planking. AA are guards fitted to protect the percolators from damage by shovels, &c. in taking out ballast or unloading a cargo. BB spaces filled with tanner's bark, charcoal, &c. or such substances as will allow the water to flow freely through them, and keep back sand, and so prevent the copper strainers, on the outer edge of the percolators, from being choked. CC the copper strainers (shown by double lines) on the outer edge of the percolators. DD the percolators, the lid or covering being open on the starboard side in midships, and shut on the larboard side and at the bilge receiver. EE limbers or receivers for water. FF the pipe which leads from the water-course down into the well prepared for it at the bilge. G shows the top of one of the main percolators opened; that on the other side is represented as shut. BP is the bilge piece. SS the water-courses, serving as supporters to the bilge piece. Fig. 3 is another transverse section, showing the alterations necessary to be made in the positions of the pump (P), pump-well (PW), and cistern (CC), in order to suit the new system. Fig. 4 is part of a longitudinal section of a merchant ves-

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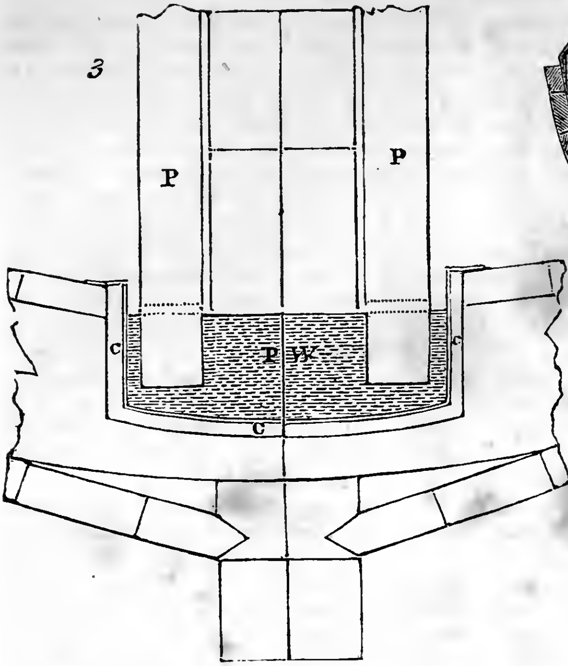

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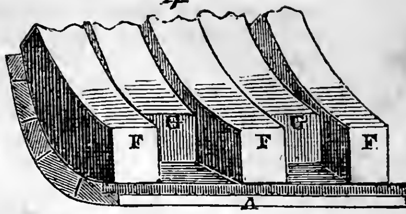

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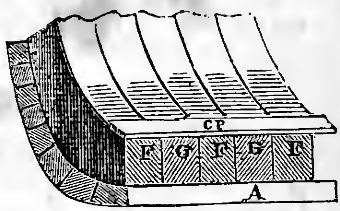


sel, cut off at a line perpendicular to the outside of the keel. F is the floor, G the futtocks. It will be seen from this, that the outside planking is reduced at the garboard strake, A, to one-half the general thickness, by the rebate for the water-course; so that, supposing the general thickness to be, as usual, 3 inches, only one inch and a half is left between the inside of the ship and the element on which she floats. Fig. 5 exhibits, in section, the same part of a vessel, as constructed on Mr. Ballingall's plan. Here the floors, futtocks, or cross pieces (G,) planks of the bottom (A), and ceiling plank (CP), form one complete mass, and present a substance of 18½ inches, (instead of 1½!) to withstand all accidents.

Among the subordinate advantages attending this improved system of ship-building, there are two which are particularly deserving of notice: one is the greater security from fire which it affords, in consequence of all the vacancies, which at present act as so many funnels to the flames, being filled up; and the other, the protection obtained from vermin, in consequence of there being no harbor left for them between the timbers and the inside and outside planks.

Various objections to the system will naturally suggest themselves to the minds of practical men; it is certain, also, that the improvements which it embraces are not equally applicable to all merchant ships: but before any ship-builder or ship-owner rejects it on either account, we would earnestly advise him to send for Mr. Ballingall's book, where he will find nearly every possible objection very frankly discussed, and every modification, which particular circumstances may call for, provided for with great intelligence and ability.

We perceive, from a letter which Mr. B. has published, from Messrs. Ogilvie & Crichton, of Leith, the builders of the Royal Adelaide, steam ship, (one of those which ply between London and Edinburgh,) that she has been built, "in most respects, on the plan now recommended," and that it is the intention of the company to which it belongs to adhere to that plan "in any vessels which they may hereafter build." We trust that so judicious and spirited an example will not be long without numerous imitators.

Mr. B.'s book contains, also, instructions for rendering vessels, already built on the present plan, more secure at a cheap rate. He particularly recommends a revival of the plan of placing a doubling on ships, as was proposed as far back as 1792, by Mr. Snodgrass, surveyor of shipping to the East India Company. Mr. S.'s plan was, "that no ship should have a thorough repair; but in-

stead of this, that its bottoms and upper works should be doubled with three-inch oak plank, from keel to gunwale, and strengthened with knees, standards, and even iron riders, if necessary—all which might be done at a small expense." Mr. S. thought that ships so repaired would "be stronger and safer, and be able to keep the seas longer in the worst weather, than new ships," (that is, new ships on the old construction;) and in this opinion Mr. Ballingall perfectly concurs. The company of which Mr. B. is manager have had two of their smacks, the Enterprise and the Fifeshire, thus doubled; and it appears from the following paragraph, which we extract from the *Scotsman* of the 28th November last, that the result has been most satisfactory:

"We understand that since the Kirkaldy and London Shipping Company's smacks, Enterprise and Fifeshire, have been fitted with double bottoms, they have frequently been deeply laden—have encountered very stormy and tempestuous weather—and were both at sea during the late very severe storm on the 10th curt., when so many vessels were wrecked, and have not admitted a drop of water through their bottoms or sides."

Nature and Formation of Snow.—If snow is carefully examined with an eye-glass immediately after it reaches the ground, it will be found to consist, for the most part, of a regular figure of transparent ice, in the form of a star of six points. On each of these points, if minutely inspected, will be seen other collateral points, having the same angles of those of the main star. Next to this figure is a single shoot often seen, resembling a small slender cylinder. Besides these two regular figures, which are the principal ones, we discover various broken points and fragments, occasioned, probably, by the wind in their descent, and by being thawed and frozen again into irregular forms.

"From hence the true notion and external nature of snow seems to appear, viz.: that not only some few parts of snow, but originally the whole body of it, or of a snowy cloud, is an infinite mass of icicles regularly figured; that is, a cloud of vapors being gathered into drops, the said drops forthwith descend: on which descent, meeting with a soft freezing wind, or at least passing through a colder region of air, each drop is immediately frozen into an icicle, shooting itself forth into several points on each hand outward its centre; but still continuing their descent, and meeting with some sprinkling and intermixed gales of warmer air, or in their continual motion and waftage to and fro, touching upon each other, some are a little thawed, blunted, frosted, clumpered; others broken, but the most clung in several particles together, which we call flakes of snow."

Clouds of snow are said to differ from clouds of rain in nothing but in the circumstance of their being in a state of crystallization. The whiteness of snow is owing to the small particles into which it is divided; for ice, it is well known, if pounded fine, will become equally white. Its lightness—for ten cubic inches of snow weigh but about one of water—is owing, notwithstanding it is composed of solid particles of ice, to the excess of its surface compared with the matter contained under it.

It is a prevailing opinion that snow fertilizes the earth more than rain, in consequence of the nitrous salts which it is supposed to acquire by freezing; but it has been ascertained by experiments, that the chemical difference between snow and rain water is very small—the former being less nitrous, and possessing somewhat less proportion of earth than the latter. Neither of them, however, it is believed, contain earth or salts of any kind of sufficient quantity to be sensibly efficacious in promoting vegetation. That snow promotes vegetation, by keeping the earth warm, there can be no doubt. The internal parts of the earth are heated uniformly, it is said, to the forty-eighth degree of Fahrenheit. The cold atmosphere of the winter months, were the surface of the earth exposed to its influence, would reduce the temperature to that degree of cold by which the roots of vegetables would be seriously injured, if not destroyed. "Providence has, therefore, in the coldest climates, provided a covering of snow for the roots of vegetables, by which they are protected from the influence of atmospheric cold. The snow keeps in the internal heat of the earth, which surrounds the roots of vegetables, and defends them from the cold of the atmosphere."—[Family Lyceum.]

To Mechanics.—Of all the pursuits of life, none more certainly insures comfort and respectability than that of a mechanic. The farmer may lose his crops by unfavorable seasons; the merchant is subject to innumerable vicissitudes; and the professional man is often compelled to struggle for years, unnoticed and unrewarded. But the man who under-

stands a useful trade, if blessed with health, need never want food, or clothing, or shelter, provided he be industrious and prudent. So well have the Jews understood this, that every Jew, whatever his rank, has in all ages been required to learn some useful trade.

Why is it, then, that so many skilful men of this class have never more than the bare necessaries of life; their families scantily supplied with food; nothing laid up against a sick day; and when death comes, perhaps a wife and children left destitute and helpless? The simple reason, in nine cases out of ten, is this: they indulge in the *useless, pernicious, wasting, destroying* practice of drinking spirits! *Useless,* as is proved by the testimony of medical men, and all who abstain from it; *pernicious,* from its invariable effects on the health, disposition, and morals; *wasting,* for it leads most generally to poverty and want; *destroying,* for respectability, property, body and soul, fall a sacrifice before it.

Total abstinence from *strong drink* is the best insurance against the world's ills, that has yet been discovered. The strictly temperate man has a clear head, a steady hand, a good appetite; his temper is under his control; he saves time; he saves money; he is respectable, whatever be his station in society. But the man who drinks but *a little* is in the high road to ruin. Of the vast multitudes of our race who have lived the drunkard's life, and filled the drunkard's grave, and entered upon the drunkard's eternity, the beginning of their downward course was *drinking a little.*

The saving of the money usually expended for spirits, without estimating any other advantages that arise from total abstinence, will, in a few years, produce a handsome competency.

Should a mechanic read this, who is 40 years of age, and who has expended 12½ cents a day for spirits, who is feeling the bitterness of poverty, by saving this sum, he might, since he was 21 years of age, have accumulated about 1,000 dollars—if he is 50 years of age, 1,500 dollars—60 years of age, 2,000 dollars—and 25 cents a day would produce twice the above amounts.

Is there a mechanic who finds it difficult to provide food, and raiment, and other comforts of life for his family, but who is in the daily practice of expending 12½ cents a day for spirits? This small sum of 12½ cents a day will, in one year, purchase the following necessaries of life, viz.:

1 barrel of flour, . .	$5 00
100 lbs. pork, and 100 lbs. beef,	10 00
Cloth for coat, . . .	6 00
Cloth for pantaloons, . .	3 00
8 cotton shirts, . . .	4 00
4 loads wood, . . .	8 00
3 pairs shoes, . . .	4 50
1 calico frock, . . .	1 25
1 bombazet do. . . .	2 00
6 yards flannel, . . .	1 88
	$45 63

These articles, in addition to what he has before felt able to purchase, will probably make himself and family comfortable; and if they "add to temperance virtue," they may be useful and happy.

Should any individual, whether employer, journeyman, or apprentice, determine, after perusing the above, to adopt the principle of *total abstinence* from ardent spirits, it is hoped he will not stop there, but will give the whole weight of his influence, by uniting with the Temperance Society, and urge on all his companions and acquaintances to do so likewise.—[Temperance Recorder.]

Knowledge. *By Rev. L. Whitington.*—There is a close connection between ignorance and vice; and in such a country as our own, the connection is fatal to freedom. Knowledge opens sources of pleasure which the ignorant man can never know—the pursuit of it fills every idle hour, opens to the mind a constant source of occupation, wakes up the slumbering powers, and unveils to our astonishment ideal worlds; secures us from temptation and sensuality; and exalts us in the scale of rational beings. When I pass by the grog-shop, and hear the idle dispute and obscene song; when I see the cart rolled along filled with intoxicated youth, singing and shouting as they go; when I discover the boat sailing down the river, where you can hear the influence of rum by the noise which it makes, I cannot but ask—Were these people taught to read? Was there no social library to which they could have access? Did they never know the calm satisfaction of taking an improved volume by a peaceful fire-side? Or did they ever taste the luxury of improving the mind? You hardly ever knew the young man who loved his home and his book, that was vicious. Knowledge is often the poor man's wealth. It is a treasure no thief can steal, no moth nor rust can corrupt. By it you turn his cottage to a palace, and you give a treasure

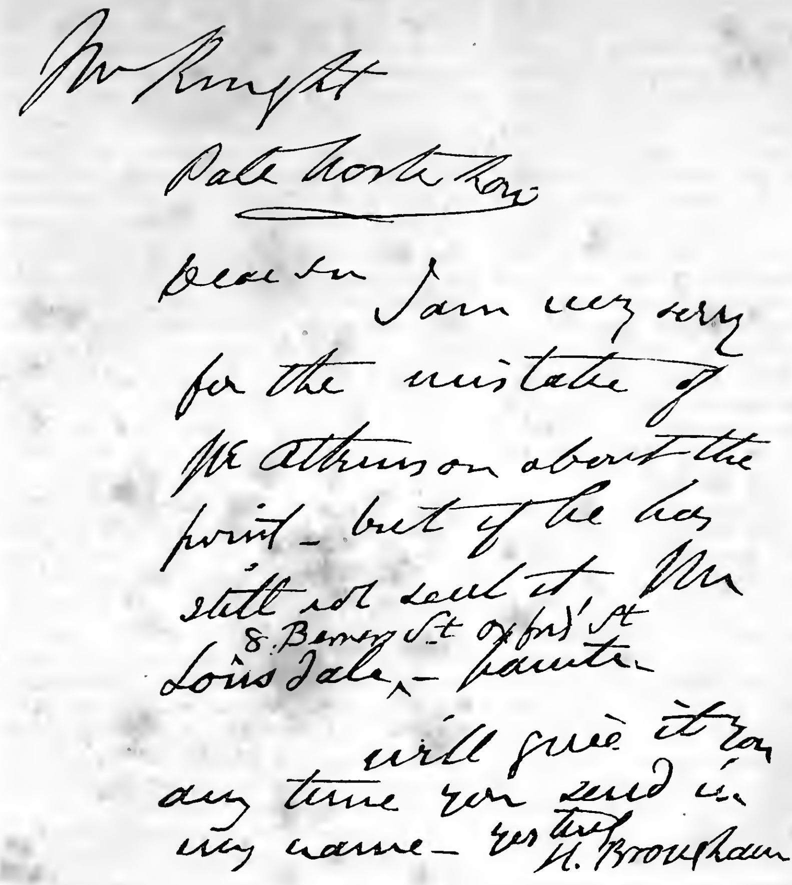
which is always improving—can never be lost. "The poor man," says Robert Hall, "who has gained a taste for good books, will in all likelihood become thoughtful; and when you have given the poor a habit of thinking, you have conferred on them a much greater favor than by the gift of a large sum of money, since you have put into their possession the *principle* of all legitimate prosperity."

Nor is it to the poor alone that this remark applies. The rich need occupation. Their hearts are often like seas, which, stagnate under a breathless atmosphere, putrify for the want of a wave. Employment, roused by some noble object, is the secret of happiness: and of all employment, mental labor lasts the longest. The body soon tires, but the mind, divided in its origin, and immortal in its destiny, pursues its labors with transient pausings; and rises from every check with fresh vigor to continue its eternal flight. What a beautiful picture does Cicero give of the secret happiness his studies opened to him! "You will not blame me, respected judges, at least you will pardon me, if, while some are hurried in business, some keeping holidays, some pursuing pleasure, and some giving their hours to sleep, while one tosses the javelin and another the dice-box, I should steal a little time for the recollection of my studies and the improvement of my mind." Yes, he loved these things better than recreation: to him they were more profitable than business, and sweeter than sleep.

Origins of Men of Genius.—Euripides, says the *Cabinet de Lecture* of Paris, was the son of a fruiteress, Virgil of a baker, Horace of a freed slave, Amyot of a currier, Voiture of a tax gatherer, Lamothe of a hatter, Sixtus the Fifth of a swine herd, Flechier of a chandler, Massillon of a turner, Tamerlane of a shepherd, Quinault of a journeyman baker, Rollin of a cutler, Moliere of an upholsterer, J. J. Rousseau of a watchmaker, Sir Samuel Romily of a goldsmith, Ben Johnson of a mason, Shakspeare of a butcher, Sir Thomas Lawrence of a custom-house officer, Collins of a hatter, Gray of a notary, Beattie of a Farmer, Sir Edward Sugden of a barber, Thomas Moore of a grocer, Rembrandt of a miller, &c. These men of genius were not men of leisure, none of them enjoyed a patrimony, and under the regime of our liberal laws, scarcely one amongst them, being neither eligible, nor even an elector, could sit in our Chamber of Deputies.

Supposed Origin of the Corinthian Order of Architecture.—The above wood cut represents the leaves of a plant called the Herb Bear's Breech, the leaves of which it will be observed are large and shaggy, and the artist has given it all that beauty of form which it is said, from the accidental circumstance of the pressure on the top, to have originated in the mind of Callimachus the idea of the Corinthian order of architecture.

"It was at first used by the ancients as an ornament to friezes and cornices, and at length to the other members of architecture, but is principally employed as the grand ornament of the *Corinthian and Composite capitals*. The Greeks used for this purpose the leaves of the cultivated acanthus (*acanthus mollis*), commonly called brank ursine, or bear's breech, from its shagginess, which grew spontaneously both in Greece and Italy. The Gothic architects and sculptors, on the contrary, have used the wild and prickly acanthus (*acanthus spinosa*), being smaller in its parts and more suited to the littleness of their styles of art. Although architecture has made the greatest use of the acanthus, yet the other arts have also adopted it as a chaste and splendid decoration. We find among the ancients, as well as among the moderns, various instruments, household furniture, and utensils, ornamented with leaves of the acanthus. These artists, in preserving the general form and character of the plant, have made their sinuosities and curves more or less prominent, to suit their purposes, and have thus given them a more sculpturesque effect. In the Corinthian capital they are executed with more fidelity and elegance: the whole plant surrounds with its aspiring leaves the vase or bell of the capital, as if attempting to lift up the abacus that covers the whole, they then turn down and form themselves into graceful volutes."—[Partington.]



Mr Knight

Pall Mall East

Dear Sir

I am very sorry for the mistake of Mr Atkinson about the print — but if he has still not sent it, Mr Lonsdale — painter
8 Berners St Oxford St
will give it you any time you send in my name — yrs truly
H. Brougham

[We make no apology for introducing to the notice of our readers a fac simile of the writing of HENRY BROUGHAM, satisfied that it will gratify many who admire the character and talents of that distinguished individual. We shall occasionally insert engravings of the autographs of men distinguished for their literary and scientific attainments, accompanied (if possible) by a short sketch of their public character.]

SKETCH OF HENRY BROUGHAM.

[Compiled from authentic sources.]

We have not forgotten that this most distinguished individual has been raised to the Peerage, and has received the highest honors in his profession that his sovereign can bestow upon him, but we prefer to speak of him in the simple name, which, like those of GEORGE WASHINGTON, JAMES WATT, ROBERT FULTON, and many others, can never receive additional lustre by any title. He was born in Westmoreland, where his mother still resides, and at an early age was called to the bar in Scotland, where he practised as a barrister for several years, devoting a considerable portion of his time to literary pursuits. It is only with his public character, whether as a statesman, an author, a barrister, or a judge, that we have to do, and in each of these has he shone with a splendor that will long cause the name of Henry Brougham to be revered and respected.

As a *barrister*, Mr. Brougham enjoyed an extensive practice for a series of years, particularly on the Northern circuit, being generally retained by the defendant, and had, in most cases, to cope with the legal knowledge and talent of Sir James Scarlett, who, for a long time, was Attorney General for the County Palatine of Lancaster. In defending particular actions for libel, and in vindicating the general liberty of the press,

Mr. Brougham has perhaps appeared to the greatest advantage. In all cases where the liberty of the subject was infringed, his appeals to the jury were exceedingly animated —he seemed, in fact, to enter personally into the feelings of his client. One of his most splendid efforts was at the bar of the House of Lords, where he appeared as Attorney General for the late Queen. The powerful arguments in support of her remonstrance against the introduction of the *Bill of Pains and Penalties* into that house, can never be duly appreciated, even by those who have read them: those only who had the great privilege of being present can form any conception of the energy displayed, and the powers of mind he evinced, on that occasion. The profound attention it commanded from the members is, of itself, alone a sufficient guarantee of its brilliancy.

We can bear testimony to the correctness of the following vivid description, written by a gentleman after hearing him for the first time plead at York Assizes:

"He rose with an expression of staid gravity and collected power. His exordium was deliberate and impressive, and I was particularly struck with the fixedness of his gaze. He seemed not so much to look *at* the jury as to look *through* them, and to fix his eye upon them, less for the purpose of seeing how they felt, than to rivet their attention, and as it were to grasp their minds by the compass of his own. The small gray eye, which in his quiescent state reveals to you nothing, now became keen and strong as the eagle's. The steadfastness of his look, together with the calm and masterly manner in which he disposed of the preliminary considerations, reminded me of an experienced general quietly arranging his forces, and preparing to bear down in overwhelming strength upon a single point. His voice became loud and commanding, his action animated, and his eloquence was poured forth like a torrent, strong, copious, and impetuous. He first took extensive views, and laid down general principles applicable to the case: then he applied these to the particular facts, examining the testimony of each witness, and showing its weakness, the suspicion attaching to it, and its inconsistency, either with itself or with the other parts of the evidence. He displayed as much skill in exposing and concentrating the weakness of the opposite side, as in exhibiting his own strength. He lashed some of the witnesses without mercy, and covered them with his sarcasm. His sneer was terrible. He then unfolded his own case with great clearness, and made it appear that he had evidence which would quite overthrow that of the other side, and leave not the shadow of a doubt on the minds of the jury. The case being one which required both physical and metaphysical observations, from involving a question of bodily and mental derangement, Mr. Brougham's universal knowledge enabled him to treat it in a very luminous manner: he seemed to combine the professional skill of the physician with the just and profound views of the philosopher. He gave a most striking picture of the diseased and doating testator, coloring it with almost poetical brilliancy, and bringing out the features with a breadth and force peculiarly his own. He gathered his illustrations from nature and from art, and levied contributions on science and literature. Every thing in the manner and matter of the orator bespoke *power*—the strength of his voice, the sweep of his arm, the piercing glance of his eye, his bitter scorn, his blazing indignation, the force of his arguments, the inevitable thrust of his retort, and the nervous vigor of his style. He despises the graces of elocution, but seems to have unlimited confidence in the strength and resources of his intellect. In short, this was the highest oratorical achievement it has fallen to my lot to hear, and it was of course successful, though it was not one of his greatest efforts."

As a *statesman*, Mr. Brougham has always appeared uniform and consistent, never swerving from his avowed principles when he entered public life. His earliest efforts as a British senator were distinguished by the same regard to the rights of individuals, and the liberties of the country, which he has uniformly manifested to the present time. Nor was he then less firm in opposition to what he deemed the encroachments of the crown, and the extravagances and abuses of the government, than he has proved since. His bold denial of the sovereign's right to the droits of the Admiralty, in 1812, will not soon be forgotten; and, though he failed in his motion on that point, few can help wishing that he had been able, during a season of enormous expenditure, to bring that prolific fund in aid of the exchequer.—We cannot deny ourselves the gratification of extracting from a speech of Mr. Brougham in 1816, on the treaty of the Holy Alliance. After wondering at the sudden resolution of three great continental powers to defend Christianity when it was not attacked, and suspecting some secret political ob-

jects in this new crusade, he said—"I always think there is something suspicious in what a French writer calls '*les abouchemens des rois.*' When crowned heads meet, the result of their united councils is not always favorable to the interests of humanity. It is not the first time that Austria, Russia, and Prussia, have laid their heads together. On a former occasion, after professing a vast regard for truth, religion, and justice, they adopted a course which brought much misery on their own subjects as well as those of a neighboring state—they made war against that unoffending country, which found little reason to felicitate itself on its conquerors being distinguished by Christian feelings. The war against Poland, and the subsequent partition of that devoted country, were prefaced by language very similar to that which this treaty contains, and the proclamation of the empress Catharine, which wound up that fatal tragedy, had almost the very same words."

Among the most prominent of his later efforts in the House of Commons, may be mentioned his lucid speech on his introduction into that house of a "Bill to amend the State of the Laws;" it occupied nearly eight hours in delivery, and so arrested the attention of a full house, that the newspapers of that time remarked that they never remembered the house so orderly. Until the year 1828 Mr. Brougham was returned to Parliament for one of those decayed boroughs which were under the immediate influence of some of the Whig peers. In that year a vacancy occurred in the representation of Yorkshire, (the largest county in England,) and he was, without solicitation on his part, triumphantly returned to fill that vacancy, although he had no connection whatever with his new constituents. He had scarcely taken his seat when he announced that it was his intention to bring forward a bill for Parliamentary Reform. A day or two previous to the one that was arranged for the introduction of that bill, the Duke of Wellington's Tory administration was dissolved, and his Majesty called EARL GREY to his Councils. The immediate consequence of that step was the elevation of Mr. Brougham to the Peerage, under the title of Baron Brougham and Vaux,* and his appointment to fill the joint offices of *Lord High Chancellor of England*, and *Speaker of the House of Lords*. The influence and power that was thus placed under his control he has used in a manner that does honor to his heart, and is quite consistent with the principles he had always advocated, in Parliament and out of it, during a series of years. Among his earliest efforts, after his installation into office, may be mentioned *his own* motion for reducing very considerably the emoluments attached to the offices he held—his sweeping reformation of the abuses of the Bankruptcy Laws—his unceasing efforts to purge the vices of the court over which he was placed to preside—his strenuous exertions in the holy cause of Parliamentary Reform, the triumph of which is mainly attributable to his and Earl Grey's inflexible and unbending political honesty—his never-tiring advocacy of the abolition of the Slave Trade—and his arguments, whenever opportunity presented itself, (and they continually occurred in Parliament,) in favor of any and all measures that had a tendency to promote the amelioration or removal of civil and religious disabilities. When it is known that during the whole period these measures were progressing, he had almost daily to attend Cabinet Councils, of frequently three or four hours' duration, yet he did more in one short session to bring up arrears of business in the Chancery Court, than had ever previously been done, having left but one cause undecided—his predecessors frequently leaving two or three hundred,—our readers cannot but wonder at the vast power of mind and versatility of talent displayed in one individual. Nor is this all; for while thus engaged in Politics, Legal Reform, Parliamentary Reform, the duties of his office in Parliament, and the due performance of his judicial functions, it is really almost incredible that he could find time to attend to literary pursuits; yet it was so. He acted as Chairman for the *Society for Diffusing Useful Knowledge*, and very frequently attended to the duties imposed upon him by that committee; and by virtue of his office, was at the head of the *London University*, and of the *King's College* also. We now turn with peculiar gratification to notice some of the gigantic efforts he has made in the cause of universal education. His resolute efforts to throw open the corrupt arcana of the most ancient and extensive of the benevolent institutions in his own country, are well known and appreciated by a discerning and grateful public. Nor

* When it was made public that Mr. Brougham was to be made a member of the upper house, solicitations were made from many with whom he had been connected in promoting various laudable objects, that he would still retain the name of Brougham, as the association of it with institutions having for their aim the welfare of mankind seemed so natural, that it would be to them a matter of great regret to be deprived of it.

have they been without success: a commission of inquiry continues to proceed in its necessary work: several great charities have already completely changed their character, and others in fear are beginning to reform themselves.

Who can but witness with pleasure the rapid progress education is and has been making for some years past? Elementary instruction is now so quickly imparting to the great mass of the people, by the most simple and economical means, that whereas in the last generation it was difficult to find a peasant who could read, in the next it must be much more difficult to find one who cannot. This is undoubtedly one of the best signs of the present times. By this the rising age of the lower and lowest ranks are receiving a moral elevation, of which no time, or change, or accident, can deprive them. This must insure the duration of wisdom, the enlargement of liberty, and the propagation of religion, by whatever political changes the frame of society may be shaken.

To HENRY BROUGHAM we are indebted for much of this: amidst his various occupations, wherever popular education was advocated, whether at the Royal Society or at the Mechanics' Institution, he was always foremost in the van.* The great interest he took in founding the London University is fresh in our memory. He was one of the prime movers in getting into successful arrangement the operation now continued with so much success in that establishment. Nor must we omit to notice the great benefits he has rendered to universal education, by planning and forming the *Society for the Diffusing of Useful Knowledge;* among the committee of which will be found men of all political parties, of influence and wealth, and great talent, combining their efforts to spread knowledge throughout the world.

As an *author*, HENRY BROUGHAM has long been familiar with the reading public. At a very early age he communicated some scientific articles for *Dr. Brewster's Edinburgh Cyclopedia*, and ever since the establishment of the Edinburgh Review he has been a zealous supporter of that work, and some of the most profound and ingenious articles that have appeared in that work were from his pen. Nor has he confined his contributinos to the *Edinburgh Review.* He is known to be the author of several papers in *Nicholson's Journal*, and in the *Philosophical Transactions*—papers which discover the varied nature of his studies, and how well he has furnished his mind with the diversities of natural and artificial, as well as legal and political science. The chief entire work which bears his name is entitled 'An Inquiry into the Colonial Policy of the European Powers.' In addition to these, a masterly pamphlet on the state of the nation, and several speeches on special occasions, which have appeared in print, deserve to be mentioned among the samples of his literary pre-eminence. In these and other productions of his pen, he shows a capacity of mind which takes in any subject, however large its dimensions or minute its details. In all his works, he is evidently much more intent upon matter than manner; yet few men are gifted with clearer perceptions, or capable of more rich and appropriate illustrations, especially from the first rate classics, with whose best passages he seems perfectly familiar.

His last avowed production is the admirable treatise on the Objects, Advantages, and Pleasures of Science, a part of which we have already transferred into our columns.

We shall conclude this imperfect sketch by a short extract from a lecture delivered at the Jefferson Medical College, by Professor Paterson, of Philadelphia, in the sentiments of which we fully concur. He says, after alluding to distinguished men in Europe, "it has been my good fortune to have associated with many other characters, who, with justice, are admitted to be the most illustrious of her sons. Before I knew them, I confess the vastness of their intellects *loomed* on my imagination. They appeared, at a distance, more than MORTALS; but, when known and examined in person, I found them merely MEN, differing in no very remarkable features of intellect or character, from the distinguished individuals with whom I have been associated, in my native city. There is only one man I have ever known, who, from the towering height of his mind, and from the rich and exhaustless stores of his information, has realized all my imaginings of a great man—a man differing from, and far exalted, by capacity and acquirements, above all others. This MAN is HENRY BROUGHAM, the present Lord Chancellor of England. He,

* Henry Brougham and his friend, Dr. Birkbeck, were among the first who responded to the call when a proposition was made to establish the *London Mechanics' Institution;* their exertions and their example did much to promote its success. They contributed liberally to its funds, and, indeed, unless such men had taken the matter in hand, we have reason to believe the attempt to found such a society, at that time, would have been worse than fruitless.

indeed, seems to be almost more than *mortal.*"—[Ed. Mec. Mag.]

The First Steamboat Voyage.—We feel gratified at being enabled to lay before our readers a letter from Robert Fulton, giving an account of his first trip by steam up the Hudson river. It is an extract from a Philadelpbia paper of 1807, and can hardly fail of being read with interest. "When Fulton started upon this first voyage, he stood almost alone in his expectations of success. He, however, was sanguine; and could he now revisit the numerous rivers and bays of our country, he would find his expectations more than realized."

New-York, August 22, 1807.

To Joel Barlow, Esq. of Philadelphia:

My Dear Friend,—My steamboat voyage to Albany and back has turned out rather more favorable than I had calculated. The distance from New-York to Albany is 150 miles; I ran it up in 32 hours, and down in 30 hours. The latter is just five miles an hour. I had a light breeze against me the whole way going and coming, so that no use was made of my sails; and the voyage has been performed wholly by the power of the steam engine. I overtook many sloops and schooners beating to windward, and passed them as if they had been at anchor.

The power of propelling boats by steam is now fully proved. The morning I left New-York, there was not, perhaps, thirty persons in the city who believed that the boat would ever move one mile an hour, or be of the least utility. And while we were putting off from the wharf, which was crowded with spectators, I heard a number of sarcastic remarks: this is the way, you know, in which ignorant men compliment what they call philosophers and projectors.

Having employed much time and money and zeal in accomplishing this work, it gives me, as it will you, great pleasure to see it so fully answer my expectations. It will give a quick and cheap conveyance to merchandise on the Mississippi, Missouri, and other great rivers, which are now laying open their treasures to the enterprize of our countrymen. And although the prospect of personal emolument has been some inducement to me, yet I feel infinitely more pleasure in reflecting with you on the immense advantage that my country will derive from the invention.

However useful this may be, it is not half so important as the torpedo system of defence and attack; for out of this will grow the liberty of the seas; an object of infinite importance to the welfare of America, and every civilized country. But thousands of witnesses have now seen the steamboat in rapid movement, and they believe; they have not seen a ship of war destroyed by a torpedo, and they do not believe. We cannot expect people in general will have a knowledge of physics, or power of mind sufficient to combine ideas, and reason from causes to effects. But in case we have war, and the enemy's ships come into our waters, if the government will give me reasonable means of action, I will soon convince the world that we have surer and cheaper modes of defence than they are aware of.

Yours, &c.

Robert Fulton.

Simultaneous Efforts.—The power of *union* and the power of *sympathy*, when combined by simultaneous efforts, are irresistible. And there is no subject to which they may be more appropriately or more successfully applied, than to the *diffusion* of *knowledge*. And there is no branch of knowledge which more strongly invites this power and these efforts, or which is more worthy of them, than Natural History. Let the friends of Education throughout the country unite their efforts in collecting cabinets of Natural History, and in exchanging specimens, the present season, and in less than a twelvemonth every town and village in the Union might be furnished with a place of intellectual and social resort, highly interesting and useful to all classes and ages.—[Family Lyceum.]

Chesapeake and Ohio Canal.—There are one hundred and two miles of the Canal let out, under an obligation, on the part of a select body of contractors, to finish it by the 1st day of September next—thirty-five days before the expiration of five years from the commencement of the work; and there is no reason to believe that the work will not be completed within the stipulated period. On the contrary, such is the progress already made, and now making, towards its completion, that it is expected sixty-four and a half miles will be in use before the 1st of June next, and the residue by the 1st of September. There are 4,500 men at present on the various works, aided by the weekly consumption of 7,000 pounds of gunpowder, and the labor of 800 horses, oxen, and mules,

and a full complement of waggons, carts, &c. Success to the great enterprise !

On the Cultivation of Bees in Single Hives and Dwelling Houses.

The following cuts represent Dr. Thatcher's hive, which is considered altogether preferable to any that has yet been brought before the public. For the description and drawing, we are indebted to Dr. Smith's treatise on the raising of bees in cities.

DR. THATCHER'S HIVE.

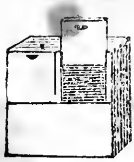


Fig. 1. This is a view in outline of a very valuable hive. The box is to be from one foot to twenty inches square. A back view, as presented in the above diagram, shows that there is a horizontal floor passing through the middle, dividing it into two equal apartments. In the lower, are cross bars for suspending the comb, as common to all hives. In the upper room, are two drawers, side by side, as represented, just filling the whole space. Through the bottom of these drawers, are small orifices, corresponding with two others through the horizontal flooring. Thus, it will be clearly understood, when the drawers are entirely in, the holes will correspond, so that the bees can run freely from the lower to the upper apartments or drawers. At the outside extremity of the drawers, (the one in sight,) a pane of glass is grooved, through which it can be ascertained what state of forwardness the deposition of honey is in. Outside of that, on a line with the box, is a slide door, represented, on the left side, as raised up, the object of which is to close it, for the exclusion of light. When the drawer is drawn out, a slip of tin is slid over the lower opening, to keep the bees below. First one drawer, then the other, may be taken out, alternating, according to circumstances.

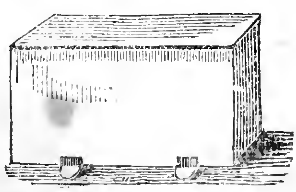


Fig. 2. This is a front view of the doctor's bee-house,—being made large enough to hold two hives, as will be noticed by the two lighting boards: no particular description is necessary, as its shape can be recognized. The door-way in the house should exactly correspond with the door-way of the hive, which is put in at the back side.

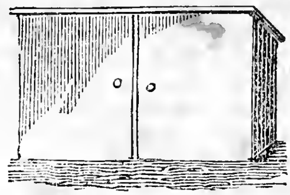


Fig. 3. The back view of the same house presents folding doors, which open for receiving and removing the hives. Trunk handles, on the ends, are very important in carrying the whole from place to place.

While on this subject we shall take the opportunity of inserting an account of Mr. Nutt's Safety Fumigator, copied from his recent work on "Humanity to Honey Bees," into the London Mechanics' Magazine :

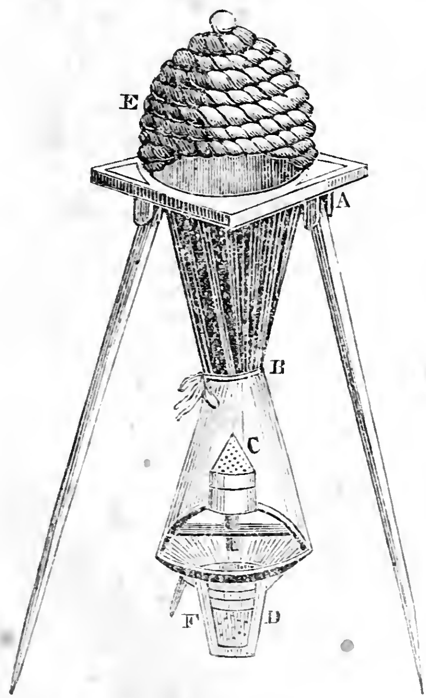
NUTT'S SAFETY FUMIGATOR.

Fumigation is rather a portentous word ; but, as soon as I shall have explained for what purposes, and in what manner, I occasionally make use of it, it will be totally divested of all *deadly* signification. In my practice it is not a bee-destroyer, but a bee-preserver ; when resorted to in my practice it is never carried, nor intended to be carried, to suffocation : but, in the operation of uniting weak swarms or poor stocks with more wealthy and prosperous ones, which I consider to be a meritorious and most humane practice—when it is necessary to examine the state and condition of even a populous colony, should unfavorable symptoms as to its healthiness or its prosperity manifest themselves,—when it is known, or but suspected, that there are wax-moths, mice, spiders, or other bee enemies, lodged in a hive, which the bees of themselves cannot dislodge nor get rid of, and which, if not got rid of by man's assistance, would soon destroy almost any colony,—when bees and their works (for I never transfer the former without transferring an ample sufficiency of the latter at the same time) are to be taken out of a decayed straw hive, and to be put into a more substantial one, or into collateral boxes, which I hold to be the best of all

hives,—and on innumerable other occasions,—it is absolutely necessary *to subdue bees* so far as to render them incapable of using that formidable venomous little weapon with which Providence has armed them, and which generally dreaded little weapon they can use so dexterously before we can operate upon them for their own good. By means of a very simple apparatus, which may be called *a fumigator*, and which is a contrivance as novel and as useful in the management of bees as any of my hives or other inventions, *bees may be totally subdued without being injured in the slightest degree, and dealt with as if they had neither stings nor wings.*

I beg leave to re-state distinctly—that, in taking off a box or a glass of honey, *no fumigation whatever is necessary*, or ever practised by me. It is only in cases such as those just enumerated that I have recourse to it; but in no case for the destruction of bees. Fumigation, therefore, in my practice is not suffocation.

The following figure is a representation of a fumigator, which a brief explanation will render intelligible:



This useful article consists of a square top-board, upon which is placed a straw hive (E), so as to show an open circular space under the hive and through the square board into the bag below. I need hardly observe that the straw hive is no part of the fumigator, but is here represented as standing upon it in order to exemplify its use. The top-board is of inch deal, and is nineteen or twenty inches square. A round piece is cut out of its centre of not more than thirteen inches in diameter—that being something near to, or perhaps rather more than, the inside diameter of a common hive—so that a hive will stand upon the wooden circumference of the part left, without there being any ledge inside, that is, any part so inclosed by the hive as to catch and detain the falling bees. From the upper edge of this circle is suspended a bag, a yard in length, made of glazed calico, the bottom part of which draws round the rim of a shallow, funnel-shaped, tin bee-receiver, which bee-receiver is about ten inches across at the top, and its lower part, or neck (D or F), is three inches and a half in length, and its throat (if I may so term it) is nearly three inches in width. To fit this neck, which is thickly perforated for the purpose of admitting fresh air when fresh air may be required, is a close lid, just like that of a common tin canister, to hold up the fumigated bees, and also to stop the ventilation when not wanted. C is the fumigating lamp, with a perforated top, through which the fume ascends, and is made conical, that so a fumigated bee in its fall cannot rest upon it, and be thereby scorched or injured, as would inevitably be the case were this top flat. The tie (B) closes the bag and keeps every bee above until the lamp and every thing below be adjusted, and it is *then* to be untied. The fumigator is here represented as standing upon three legs, made fast to the top-board by small bolts, as at A; but it is quite as convenient in practice, and more portable, if, instead of these legs, it be made like a common scale, with a cord from each corner, which may be gathered into a small iron hook, and thereby suspended from the branch of a tree, or from any other convenient place, when used; the lower part of the bag is represented as being transparent, but that is done purposely to show how the lamp is placed inside when prepared for operation.

By persons inexperienced in such matters, it may be thought to be an extraordinary feat to unite the bees of one hive with those of another—to bind, as it were, the legs and wings, and *pro tempore* to render

useless the sting of every individual bee, until such union be effected. Nothing, however, is more easy, nor is any part of apiarian practice attended with more pleasing consequences to the operator, or with more important and beneficial results to the bees themselves. When in a state of temporary intoxication from the fume made to ascend through the perforated tin (C) into their hive, these beautiful insects are perfectly manageable,—perfectly harmless.

This intoxicating fume is caused by introducing into the fumigating lamp a piece of ignited vegetable substance, called puck, puck-ball, or frog-cheese, or, most commonly, *fuzzball.* It is a species of fungus, or mushroom, and is plentiful enough in the autumn in rank pastures, and in rich ed-dishes. Shepherds, milk-maids, or country schoolboys, are well acquainted with them,—know very well where to find them,—and for a mere trifle will easily pick up as many of them as will supply the demands of twenty apiarians. They are frequently as large as a man's head, or larger. In 1826, I had an unripe white puck-ball, which weighed ten pounds. When ripe they are internally of a brown color, and, turning to powder, become exceedingly light, and are then properly *fuzzballs.* When you have procured one of these pucks, put it into a large piece of stout paper,—press it down therein to two-thirds, or, if you can, to one-half, of its original size, and tie it up very closely,—and lastly, put it into an oven some time after the household bread is drawn, that is, when the oven is nearly cool, and let it remain there all night, or until it will hold fire, and smother away like touch-wood, that is, burn without kindling into flame. In this state it is fit for the lamp, and may be used in the manner following:

Take a piece of this prepared fungus, as large as a hen's egg (it is better to have too much of it than too little to begin with); ignite one end of it with a candle, and then put it into the fumigating lamp; next fix the lamp in its socket over the bee-receiver, and place the whole inside the bag, as shown in the plate, and untie the fastening (B) round the middle. In a very short space of time the bees in the hive placed upon the top-board (which is necessarily the first thing to be attended to in every operation of this kind) will be totally under your control. The operator should be particularly careful to close every vacancy, however small, that there may happen to be between the top-board and the edge of the hive, by tying a cloth round it—the hive—as soon as ever it is placed upon the board. This precaution will prevent the escape of any of the fume, and will also prevent the bees from annoying the operator during the fumigating process.

In the course of a minute, or very little more, you will with delight hear the bees dropping like hail into their receiver, at the bottom of the fumigating apparatus.

When the major part of them are down, and you hear but few fall, you may beat the top of the hive gently with your hands, in order to get as many down as you can. Then loosening the cloth, lift the hive off and set it upon a table, or upon a broad board, prepared for the purpose, and knocking the hive against it several times, many more bees will fall down, and perhaps the queen among the rest; for as she is generally found to lodge near the crown of the hive, she often falls one of the last. If the queen is not among the bees on the table, then search for her among the main body in the bee-receiver; first, however, putting them upon the table, if you discover her not before lying among the uppermost bees therein.

During this search for the queen you must be proceeding in a similar manner with the bees in the other hive, with which those already fumigated are to be united. As soon as the bees of the hive last fumigated are all composed and quiet, and you have found and secured one of the queens, you may put the bees of both hives together into one, mingling them thoroughly together, and sprinkling them at the same time with a little ale and sugar; then put them and *one only* of the two queens among the combs of the hive you intend them to inhabit, and gently shake them down into it. When you have thus got all the bees of your two hives into one, cover it with a cloth, and bind the corners of that cloth close about it, and let them stand during that night and the next day, shut or closed up in this manner, so that a bee may not get out.

In the evening of the following day, at the dusk hour, loose the corners of the cloth and remove it from the mouth of the hive (taking care of yourself), and the bees will with a great noise immediately sally forth; but being too late to take wing, they will presently go in again, and ever after remain satisfied in and with their new abode—new, at least, to one half of them, and new to the other half also when transferred into a fresh hive, or into boxes.

Account of the Arrival of the "Comet" Fire-Engine at Berlin, and of the Experiments there made with it. [From the Allgemeine Preusische Staats-Zeitung, for Dec. 2, 1832.]

To the many useful applications of steam power which have been witnessed of late years, we have now to add that of working fire engines by steam. The merit of having first manufactured such an engine is due to Messrs. Braithwaite & Co., of London.—This machine, which consists of a 6-horse power steam engine, and the pumps worked thereby, rests upon a carriage, which can easily be drawn by two horses, and, in consequence of the peculiar construction of the steam boiler, can be brought into action in the course of thirteen minutes. Its effects are extraordinary; and its utility has been already exemplified at several large fires in London, among which may be mentioned the Argyll Rooms in Regent street—English Opera House, Strand—and, lastly, the celebrated brewery of Messrs. Barclay, Perkins & Co. On the last occasion the engine particularly distinguished itself; and after the fire, and the total loss of the steam engine and pumping apparatus, it was of extraordinary service to the proprietors of the brewery in pumping, for 25 days, the beer brewed in the part of the building that was saved, to the vats, 50 feet above the level of the street.

As the double-acting pump of the engine, which is worked by a 6-horse steam engine, is $6\frac{1}{2}$ inches diameter, and makes 30.14 inches double strokes per minute, it can pump in a day of 10 hours, 8,640 cubic feet, and, in 25 days, 216,000 cubic feet, English measure, to the height of 50 feet.

The Prussian Ministry of the Interior for trade, traffic, and building, has had a similar engine, but of still greater power, made by Messrs. Braithwaite & Co. It works by an engine of 15-horse power, and is the first of its size made at their manufactory. The makers have named it the "Comet." There were several trials made of it to-day on the Building-ground of the Court-marshall office, in University street, which proved equally satisfactory with those made for two whole days at London. The engine consists of two horizontal 10 inch double-acting pumps, which are worked by two small steam engines of the united power of 15 horses. The pumps, engines, and boiler, with connectors, rest on four of Jones's (of London) patent wheels, (cast iron boxes, with wrought iron spokes and rims,) and can, notwithstanding the immense weight of four tons, (when the boiler is charged,) be easily drawn by four horses on a paved road. Those patent wheels are on the same principle as those with which the Artillery Company at Woolwich have made, according to the *United Service Journal*, such satisfactory experiments. In the course of 20 minutes from lighting the fire in the boiler, the engine was started, and made then 20 to 25 strokes per minute. The pumps being 10 inches diameter, they will draw, with 25.14 strokes, 57 cubic feet per minute, or 3,130 cubic feet per hour, and throw it through the hose to great heights and distances. To the air chamber there may be fixed four sets of hose, which can be used together or separately. By using one hose, and a jet of $1\frac{1}{4}$ inch diameter, the water was thrown vertically to the surprising height of 120 feet; and at an angle of 45° to 50°, to a distance of 164 feet. The effects of this engine are accordingly very great, and can even be increased by giving it a quicker stroke. The engine is destined, in particular, for the protection of the Royal Palace, the Cathedral, Museum, new Sufferance Warehouses and Courthouse, the Governor's Palace, his Majesty's Palace, that of her Grace the Princess of Lignitz, the Life-Guard House, the Finance Ministry Office, the Academy for Singing, the University, the Palaces of the Queen of the Netherlands and of his Royal Highness Prince William, the Library, the Office of the Minister of the Interior for Trade, &c., the Opera House, and the Royal buildings in Burg street.

For the supply of the great quantity of water necessary for the engine, cast iron suction pipes are to be laid under the pavement, with plugs to which the suction of the engine may be fixed. In consequence of this arrangement, the engine may be used as well for extinguishing the fire itself as for supplying other engines with water. As there are 400 feet of hose belonging to it, the water may even by that means be conveyed to great distances; and a large plane may be protected by placing the engine into a circle, the radius of which is 400 feet. Finally, it is scarcely necessary to observe how advantageous the application of steam is for working fire engines, whether they be on barges or carriages; in the first case without exception—in the latter where there is no want of water. The time of 13 or 20 minutes, which the generating of steam requires, with small or larger engines, is no drawback to their utility, as steam is generated whilst the horses are

being put in, and while the suction is being connected to the water pipes by engines on carriages. The engine requires an engineer, a stoker, and one to four men to attend to the hose. It saves the strength of 42 to 105 men, according to its size, from six to fifteen horse power; it does not tire, works regularly, and requires no relief. The diminution of a crowd, which is so disagreeable at a fire, and of the space necessary for many small engines—the greater distance from the fire in which this engine may be placed, and the simplification of directing firemen's exertions,—are certainly undeniable advantages. If, therefore, even the application of steam fire engines by land may be with us but small, as sufficient water can only be produced near rivers or canals, (there being no water-works,) the utility of these engines must call for their general adoption in barges, where there is no such impediment.

London Mechanics' Institution. [From the London Farmer's Magazine.]

Mr. Alexander Gordon concluded his short course of lectures on steam carriages on Friday night. The following is his conclusion:

Why, then, it is always asked, are steam carriages not running already on the highway, if the advantages be so great? Ignorance is the reason. You must remember, very few know any-thing of a steam engine; their business, their habits, their pleasures, their urgent duties, have prevented them. I venture to believe, that even in well educated society there is not 1 in 200 who knows wherein consists the difference of a high-pressure steam-engine and a low-pressure steam engine. It has not been necessary for them to know.

You know very well that you cannot pass your hand from the crown of your head to the sole of your foot, and detect any piece of dress which is not directly or indirectly the produce of steam labor. Yet 1 in 200 of well educated society might be puzzled to say with certainty that steam had been instrumental in any part of their dress. Did they but know what it has done, they might speculate on what it can do. That mighty agent, which at the word of the Omnipotent removes hills and overturns mountains, exalts valleys, and rends the earth, which may be instrumental in the "wreck of matter and the crush of worlds," when lent to man does weave a fabric delicate in texture as the gossamer's web.

How few know that in one factory alone steam spins in a single day thread 60,000 miles in length, and yet so delicate that your breath would break its continuity.

Still we are told that steam carriages will never do the country any good.

It were a curious but a fair analogy to draw betwixt cotton productions and agricultural productions. In the former it does every thing—in the latter, what? Had not this beneficent agent been extended to us, our cotton and other manufactures would now be requiring protecting duties to encourage home production. The steam engine renders such unnecessary, and we have not only abundance at home, but a ready market abroad.

India was formerly our rival in cotton fabrics. How has the steam engine altered the case! Now, although at Calicut (the place that gives calico its name), in the East Indies, labor costs only 1-7th of what it does in England, we are enabled, I may say, by the steam engine, to card, spin, and weave Calicut-gown cotton at Manchester, to dye it, to print it, and, after affixing the Oriental mark, we export it again to India. Not only is the cheap labor of the natives of no avail; we rival them in their own market, after a carriage of 28,000 miles, and they cannot tell the difference of the article.

Corn can as certainly be produced for less than 60s. in England. The anticipations of the future are strongly connected with the history of the past. We see the dawn of brighter things for renovated England,—not an obscure indication, but a distinct appearance. * * * * Agricultural produce costs in England twice the sum it does on the continent. The question then is,—Can it be produced for less? Certainly. We remember that 60 years ago a pound of cotton could only be extended to a thread of 17,000 yards, and this by the close and diligent application of a man for the whole day. But by steam power, a pound of fine cotton can now be extended into a thread of 167 miles long, with the attendance of a mere child.

Is it then too much, I ask, to expect that when the steam engine is our motive power on roads, and extends its blessings to agriculture,—to plough, to harrow, and to reap, —that then corn restrictions will be nugatory, —that then we shall have abundance at home, and may even export our corn? The cases are analogous. The results of machinery will be similar.

I cannot close this short course without thanking you for your attention, and expressing my delight that I have found you interested in the subject. It is a momentous one.

I have only shown you a meagre outline; you will find much to fill it up with by allowing it space in your thoughts.

Let me remind you, that the decision of the committee of the House of Commons was conclusive in every particular, that "the steam carriage is one of the most important improvements ever introduced."

Let me remind you, that though Hargraves, the mechanic, was an illiterate weaver, he revolutionized the cotton trade. But the members of the Mechanics' Institution, having that knowledge which is power, are a thousand times more able in this instance to change the customs of the age. Hargraves contended single-handed; but here we can unite.

Now let each costermonger's wretched horse remind you of what horses suffer.

Let each quick-going stage remind you that the effective tractive power of the horse is, by the speed which obtains, reduced to a mere fraction, and is maintained at a loss of physical power equal to 88 per cent. That the horses employed for every coach plying betwixt London and Birmingham are 100 in number, and that they do, in reality, consume the food of 800 human beings.

Let each pair of post-horses remind you that they consume the food of three fat oxen; in short, that the horses of the country consume the food of 16,000,000 of our fellow creatures. And when you hear of a ship-load of emigrants, remember that, twist the case as you may, still the affecting truth will meet your inquiries—they are torn from home, country, kindred, and friends, to leave a sufficiency for the now unproductive consumers of their food.

History seems to point exultingly to the record of mechanics, and radiant with splendor shines the name of their philanthropic founder. Our excellent President (Dr. Geo. Birkbeck) has set you an example, and you will dim the lustre of his name if you remain silent or inactive spectators of this master movement in mechanics. Nay, you will betray a lack of sound philosophy and humanity,—a want of feeling for your starving fellow man, as well as a disregard for the appointments of our Maker.

The British Iron Trade.—Great Britain has been particularly fortunate in possessing inexhaustible mines of coal and iron —two natural products which give the country a prodigious superiority over the adjacent continental nations. By means of these valuable materials, and the skill of the inhabitants, we are able to export hardware goods and machinery of every description, on the most advantageous terms, to all parts of the world. From an early period the natives have enjoyed a high reputation for the manufacture of warlike weapons; and, what is justly esteemed a compliment to the people, it has more than once occurred that they have supplied fire-arms, bayonets, swords, and daggers, to the very nations with which they are at war: thus furnishing instruments for their own annoyance and destruction.

The iron trade of England is one of the chief staples in the country, and gives employment to a vast body of laborers and artizans. Every where our observation is attracted towards the combinations and results of this extensive branch of traffic, and we find that there is even less to create astonishment in the multitude and variety of the products, than in the exquisite perfection of the machinery employed—machinery seeming almost to usurp the functions of human intelligence. "No one, for instance," says a writer in the Quarterly Review, "can adequately comprehend the mighty agency of the steam engine, who has not viewed the machinery of some of our mining districts, where it is employed on a scale of magnitude of power unequalled elsewhere. In Cornwall especially, steam engines may be seen working with a thousand horse power, and capable (according to a usual mode of estimating their perfection as machinery) of raising nearly 50,000,000 pounds of water through the space of a foot, by the combustion of a single bushel of coal. No Englishman, especially destined to public life, can fitly be ignorant of these great works and operations of art which are going on around him; and if time can be afforded in general education for Paris, Rome, and Florence, time is also fairly due to Manchester, Glasgow, Leeds, Birmingham, and Sheffield. Nor, speaking of the manufactures of England, can those be neglected which depend chiefly or exclusively on chemical processes. It may be conceded, that the French chymists have had their share in the suggestion of these processes; but the extent, the variety, and success with which they have been brought into practical operation in England, far surpass the competition of any other country. These are, perhaps, from their nature and from their frequent need of secrecy, the least accessible of our manufactures to common observation: yet they, nevertheless, offer much that is attainable and valuable.

Connected with our manufactures are the great works of the civil engineer, which cover every part of the kingdom—the canals, roads, docks, bridges, piers, &c.: works which attest, more obviously than any other, the activity, power, and resources of the country."

It was lately computed that about 700,000 tons of iron are annually made in Great Britain, a very large proportion of which are the produce of South Wales and Staffordshire. In Scotland, 36,500 tons were, at the same time, made. The chief consumption of this immense quantity of metal is in the island itself, there being little more than 100,000 tons exported. The value of that which was exported was, for British iron £1,226,617, and for hardware and cutlery £1,387,204.

The great seat of the iron manufacture in Scotland is at Carron, a place in Stirlingshire, situated on the north banks of the river Carron, about three miles from the south shore of the Firth of Forth, and a short way north of Falkirk. The Carron iron works, which are reckoned one of the greatest wonders in North Britain, are the property of a chartered company, established in 1760. They are employed in smelting ores, and the manufacture of all kinds of cast iron goods, whether used in war or agriculture, domestic economy, or any other purpose. Cannon, mortars, howitzers, and carronades of every description, are here made in the greatest perfection. The *carronade* now used in warfare was first made at Carron, and hence assumed its name. Shot and bomb shells of every sort and size are also made, and on a scale which rivals the manufactories of Germany and Russia. This large establishment is placed in the midst of a country, possessed of inexhaustible stores of the materials of its manufacture, and has every facility of export. Besides these qualifications, the country is rich in every species of produce, and able to support a dense population. Including those employed in the works, and those engaged in the mines and pits, with the individuals employed in the coasting and carrying trade, the whole will amount to between 2,000 and 3,000 persons, who subsist directly by the works. To a stranger, the approach to the establishment from the north, in a calm night, is striking and terrible, from the illumination of the atmosphere, which is seen at a great distance, the noise of the weighty hammers resounding upon the anvils, the groaning of blast machines, and the reflection of the flames in the reservoir which bounds the works on the north, as in a large mirror. The scene is much admired, and often resorted to in "the calm summer e'en," even by the local inhabitants.—[Chambers' Journal.]

The Real Capabilities of Steam Carriages on Common Roads. By SAXULA. [From the London Mechanics' Magazine.]

The doubts and sneers that have been cast upon steam travelling on common roads have, I believe, been principally caused by the exaggerated statements of over-sanguine inventors. The disease is not cured because the patient deceives the doctors.

I have labored hard for many years at the theory and practice of locomotion, and found I am somewhat wiser for my trouble; but being wholly unassisted, my progress is necessarily slow. I consider all the noted steam carriages that have started have been overdriven, and will knock up in consequence. My theory and practice show me that a steam horse will do just as much as a living horse. It so happens that the working pace of steam (or piston rate) is about the working rate of a horse at his best; namely, $2\frac{1}{4}$ or $2\frac{1}{2}$ miles an hour, and at this rate either horse will draw a ton on common roads, good and bad, up hill and down, for a day together, and this is a fair horse's work.

Now, if a *real* 8 horse-power engine be made, and its total weight be 4 tons, it will draw itself and 4 tons of goods at the rate of $2\frac{1}{2}$ miles an hour. At five miles an hour it will draw only itself, and at 10 miles an hour it will only exert a power able to draw half of its own weight, through all roads; for locomotive machinery follows the laws of common machinery,—if the speed be increased the load must be lessened. 'Tis true, this 8 horse engine may be forced to much higher exertion, at the risk of speedy destruction.

It may be urged that coach horses do much more in proportion to this. True; but they can only work a few hours each day. Let our steam horses be considered as perpetual coach horses (which is allowing a great strain on the machinery, compared with stationary machinery,) and then how will the account stand? Four horses can take a stage coach of two tons at 8 miles an hour; consequently a steam engine of 8 horse power, to equal this, must weigh of itself only two tons, and have a load of two tons, being half a ton for each horse. But if the required speed be 16 miles an hour, then the engine must weigh only one ton and draw another ton. Therefore, *Query*,—Can a full 8 horse power en-

gine be made, capable of continual work, that shall weigh only one ton? If so, 16 miles an hour can be maintained, and if not, the speed must be reduced as the weight is increased; and even in this parallel, where hills or bad roads occur that require the living horses to drop their speed to a walk, and then do their best, the steam engine (at the 8 miles an hour pace) must act on a lever nearly equal to the radius of the propelling wheels. This is a simple calculation, and involves the true capabilities of steam carriages on common roads.

Theoretically, I think Mr. Walter Hancock's boiler the best, having the greatest heating surface with the least weight; but I imagine thin metal heated by blast will not wear to pay charges. In fine, I think at present a locomotive engine cannot be made substantially for regular economical work under half a ton weight per horse power; and if so, great speed cannot be expected, and long levers must be used in difficulties, which is only coming round again to my old story. I understand Mr. Hancock has been fitting up his carriage with longer leverage.

Has it ever been well considered, that in stage coaches the first mover (the horses) goes at the same rate as the vehicle? The power and resistance work an equi-armed lever, namely, the spokes of the wheels; whilst in steam carriages, *the first mover (the pistons) never exceeds 2½ miles an hour*, yet the vehicle is wanted to go 20 miles an hour: consequently 8 times the power are required to do it, that would be required at 2½ miles an hour.

He who builds an engine to propel a common stage waggon, will, in my opinion, soonest find his reward; and even here two steam horses will have to be maintained to do the work of one living horse, by reason of the weight of the engine, fuel, water, &c.

November 5, 1832.

Paces of the Snail.—The locomotion of animals which have no feet is a curious subject of physiological investigation, and has in some instances well rewarded the study of naturalists. The leech, the earth-worm, serpents, &c. have each their peculiar modes of progression; but the snail, as any person may observe, moves differently from all these, gliding along without jerks or undulations in any part of its body, and each point of the surface advancing simultaneously: for, the belly being smooth, with no appendages to perform the office of feet, the whole body consequently moves at once. Mr. J. Main, who has written an ingenious paper on the subject, has studied the motions of the Limax maximus, L. ater, L. rufus, and L. agrestis; and, by placing them on glass, the muscular motion was remarked to be from the tail to the head, and, of course, the movement cannot be by impulses. Mr. Main thinks the movement is produced by the propelling force of the slime projected in a retromissive manner from all parts of the body at once.

Ogle's Steam Carriage.—On Saturday morning last, Mr. N. Ogle, accompanied by Mr. Baggage, Mr. C. Bisheoff, and several other gentlemen, proceeded from the Bazaar in Portman street, to the residence of Mr. Rothschild on Stamford hill. The distance of seven miles was accomplished, notwithstanding the crowded state of the roads, in 31 minutes.—[True Sun.]

The Great British Railway.—There is now every reason to believe that the London and Birmingham Railway Bill will pass the legislature in the course of the coming session, and that the projected plan for a railway communication between Birmingham and the two northern hives of industry, Liverpool and Manchester, will also be shortly carried into effect. Proposals are also on foot for continuing the line through Carlisle to Glasgow, with a branch to Newcastle; on the completion of which the metropolis would enjoy the facility of a rapid intercourse with all the great towns of the north. As either the Southampton or the Brighton railroad scheme may be expected to succeed, we shall only want our northern friends to extend the Glasgow railway to John o' Groat's, to have an iron road from one extremity of the island to the other! Would not this afford a good opportunity of putting in practice some method for the instantaneous communication of intelligence by means of electricity?—[London paper.]

Practical Treatise upon Road-Making.—Mr. Williams, Engineer, of Cincinnati, Ohio, has issued a prospectus of a volume he proposes to publish on the laying out and constructing M'Adamized roads. Mr. W. proposes to illustrate his book with about 100 engravings, and deliver it to subscribers at the low price of

$3, bound and lettered. Such a work is a great desideratum in this country; of Mr. Williams' fitness for such a task there can be no doubt. With his prospectus he has printed letters from some of the most distinguished individuals in the United States, including engineers, presidents of turnpikes and railroads, and statesmen, friends of internal improvements—among the latter we find the names of H. Clay and J. C. Calhoun,—all agreeing that Mr. W.'s practical experience on such subjects renders him peculiarly qualified for such an undertaking. We subjoin a portion of his address to the public.

"In writing and compiling the proposed work, it shall be my aim neither to be tediously particular, nor obscurely brief; but as the safer, I intend to fall into the former rather than the latter error. My endeavors shall be to write a plain practical treatise, and not to make any unnecessary display of science or skill. The book most needed is one that might enable any person with a tolerable education, by close application, to make a first rate road, or to improve in the best manner those already made. Such a book, it is hoped, the proposed one may be. It will embrace nothing but what is connected with the laying out, the construction, the use, or the repair of those kinds of roads upon which every one may be his own carrier, or travel in the way his fancy or circumstances may point out to him. Nevertheless, it is presumed that the Canal and Railroad maker may be interested, if not instructed, by a perusal of it.

"The matter in the work will be treated in something like the following order:—Introduction, Road Companies, Charters, By-Laws, Engineers, Mapping, Superintendants, Directors, Lettings, Contracts, Masonry, Bridging, Graduation, M'Adamizing, Repairs, Tolls, Artificial Roads generally, Substitutes for stone in the construction of artificial roads, Common Roads, Street Pavements, Wharves, Landings, Ferries, Viaducts, Yards, Walks, Vehicles, &c. &c. Believing that no man of observation is so ignorant that he cannot teach, nor so wise that he may not learn, a request is made to all who can communicate any useful matter, on any of the above subjects, to do so; but, at the same time, the necessity of their paying the expense of sending their communications will appear to them, and be cheerfully borne by those who have the prosperity of the country at heart."

[*From the American Railroad Journal.*]

We are indebted to Charles H. Hammond, Esq. of Bennington, Vt., for the interesting and valuable letter from J. Loudon M'Adam, Esq. of Hertfordshire, England, upon the subject of road making, which will be found in this number of the Journal. It will, we are sure, without any solicitation on our part, be read with great pleasure by all who take an interest in the improvement of our system of road making, emanating as it does from a gentleman of intelligence, and long experience in the business upon which he writes.

Hoddesdon, Hertfordshire, (Eng.)
November 14th, 1833.

C. H. Hammond, Esq. Bennington, Vt.

Sir,—In the Railroad Journal of New-York, of 21st March last, Vol. 1, No. 13, I saw a copy of a letter from you to the Hon. George Tibbets, by which I am glad to see that the science of road-making has attracted notice in America, and I am flattered by your approbation of the system which I have ventured to recommend to my country.

As an acknowledgment of my obligation to you for your favorable opinion, I take the liberty of explaining to you the difficulty, I had almost said the impossibility, of transmitting a proper and effectual knowledge of road-making by writing, so as to convey such a body of information as will enable a person to act upon it in every case and on every emergency that occurs; and unless the party directing be possessed of this knowledge, he will be constantly in danger of misdirecting in some seemingly trivial matter that deranges the works and defeats the object contemplated. However well his theory may be based on true principles, a practical man must also know, intimately, the value of every species of service to be performed by workmen, as compared with the value of labor in the country; it is in vain to expect economy to be obtained in road-making, unless the whole work be done by the laborers by piece-work. Whenever day labor is the system, extravagant expenditures and boundless profusion will be the consequence.

The sub-surveyor, whose duty it is to be constantly present where the work is proceeding, ought to be able to fix the price of work by weight or measurement, and to make fair and equitable bargains with the workmen, by which they may be enabled to earn the reasonable wages of the country, using a proper degree of

industry; and the sub-surveyor ought to be a very good judge of the quality of the work, so as to insure to the public the proper value, as well as quantity of labor, for the money.

The sub-surveyor must have a perfect knowledge of what work is necessary to be done, and the manner and cost of its performance; he must be able to give to new and unpracticed workmen such instructions, and to supply them with such tools, as may enable them, with due industry, to earn fair wages at reasonable prices.

He must also have good practical experience in draining a road: difficult as it may be to explain the other branches of road making, this it is impossible to describe or to teach by any other process than experience, under a skilful person; the shape of the country, the section of the road, its situation in respect to the adjacent grounds, the nature of the soil, and many minor considerations, vary so often in every part of the same road and country, that the practice can be described and defined by no fixed rules or instructions. If the sub-surveyor be not a practically skilled drainer, the road he has the charge of will neither be good, durable, or preserved economically, unless his superior officer, the general surveyor, takes on himself this duty of directing the operation, which I and my family have been frequently obliged to do.

Our plan of distributing piece-work among the workmen is to employ them in gangs, never exceeding five men; one of whom, selected by themselves, is called the gangman, and with him the bargain is made by the sub-surveyor for pieces of work sufficient to employ the gang about a week, as no great loss or damage can happen in that time and on that quantity. If the gang do the work well, and earn fair wages by industry, they get another bargain; if idle, or disposed to slight the work, they are not again employed, by which means a road is in a short time supplied with good and expert workmen.

When the improvement of roads commenced in England in 1815, the cost of repairing the Bristol roads (178 miles) was about £19,000 annually, the roads then in such a condition as to be almost all under notice of indictment—at present the annual cost for repairs is about £13,000, including salaries for management.

I took the charge as general surveyor of the British roads in 1815, and was obliged to instruct all the sub-surveyors, (nine in number;) they again instructed others, by which process we obtained, after a few years, some skilful surveyors. We have found, experimentally, that from one to two years are necessary for instructing a sub-surveyor, according to his diligence and ability; and, even when instructed, it is prudent to place him for some time near a more experienced surveyor, or more immediately under the inspection of the general superintendant.

The system followed by my family and myself is to take charge, as general surveyors, of a number of district of roads, or, as called in England, trusts; upon these we keep one or more surveyors, according to the number of miles and the work in each trust. We employ at present, under my sons, grandsons, and myself, about a hundred sub-surveyors, and have in charge a considerable number of roads both in England and Scotland; but our system is by no means universal: many sets of trustees are attached to old surveyors, many to old practices. Economy and improvement have yet a great field to conquer in Britain—in your recent country you have fewer obstacles to encounter.

The importance of skilful and respectable superintendance in the officers of roads is ill understood in this country—deep-rooted abuses, old prejudices, and some great defects in our system of road law as to contract, have all contributed to prevent the whole benefit we might derive from good roads at a moderate cost, notwithstanding the experience of eighteen years.

I am not acquainted with the laws and regulations under which the roads in the United States are managed: perhaps their care depends upon the Legislature of each individual State; perhaps upon a still smaller subdivision of authority, whereby it may be difficult to make an exertion for attainment of the practical science necessary for the general interest; but if such an exertion could be made on an efficient scale, I am persuaded it would be of infinite benefit in producing immediately, at a reasonable expense, serviceable roads, which could be upheld at a cheap rate. It would also prevent the introduction of improper plans of road work, which are frequently found difficult to be eradicated.

Should it be practicable to induce one or all of the States to attempt the introduction of a regular uniform system of road work and road management, on the most approved and

economical plan, it would be necessary to send some persons to this country to serve an apprenticeship of not less than a year. Both classes of surveyors and sub-surveyors require the necessary practical information; their duties are distinct, although pointing to one object; their station in society ought also to be distinct.

The general surveyor should be a well informed young gentleman, entering into life with a value for character, and having connections and a station that would place him beyond the reach of suspicion himself, and give him the consequence and authority so absolutely necessary for the due discharge of his duty in defending the interest of the public, in addition to all the detail of the duties of a sub-surveyor, in which he ought to be thoroughly informed; he must be an expert accountant, so as to be able to keep an effectual and steady control over the weekly accounts of the sub-surveyors; compare the work done with the money paid, with such skill as to preclude the possibility of extensive imposition proceeding for any length of time undiscovered. This service can only be performed effectually by a gentleman perfectly qualified; and the sub-surveyors feeling themselves under the orders of an efficient officer, are attentive and careful in their conduct, but very soon throw off their circumspection when only under the authority of trustees, who occasionally, superficially and unskilfully, look into their accounts, and are quite unequal to the necessary task of comparing the extent and quality of the work done with the money expended, or of giving a little direction to the work when they find it defective.

Sub-surveyors should be selected from the class of yeomen in England—in America of respectable farmers: their early acquaintance with agricultural management has been found useful. The duty of the sub-surveyor is ministerial; he is to take the orders of trustees through the general surveyor, and to possess the skill and experience requisite to have the work performed in a proper manner, and at a fair price; to be able to measure work correctly, and to settle with the laborers. His knowledge of figures should be such as to enable him to keep an intelligible account, to fill up correctly the form of the weekly account which he will be furnished with, and to deliver it, in duplicate, every fortnight, to the general surveyor: one copy to be delivered to the treasurer, the other to remain as a record with the general surveyor, at all times open to the inspection of trustees and others intrusted.

Experience during eighteen years' practice has instructed us in many particulars that appear trivial, but which we find to be very important in making a road solid, impervious to water, smooth in the surface so as to be easily travelled upon, and consequently kept in repair at a reasonable expense. Some theoretic opinions, at first adopted, have been corrected—others given up as erroneous; the science of road-making is still capable of improvement for the benefit of mankind.

Your magnificent river, canal, and railroad conveyances, will not supercede common roads; those great works promote industry, wealth, and population. Communications must be multiplied to answer the increased demands of commerce, and connect those important works. America will require a number of stoned roads in proportion to the extension of her other great improvements; and it will in the end be greatly conducive to economy and good effect, if, at once, the States should take decided measures to have a certain number of persons practically instructed, which is the only instruction that will ever be found effectual.

Having resided fourteen years in America, and having seen the effect of severe frost and sudden thaws on roads, I am quite safe in assuring you that more skill and care in the construction of roads are required in America than in England.

I have read in the Railroad Journal of New-York, of 18th August, 1832, Vol. 1, No. 34, a kind of controversy, about a road called the Third Avenue: if that road be constructed as described by one of the disputants, I must say that there has been much labor and expense bestowed in giving the road every possible chance of being rough in the surface, and consequently inconvenient for carriages, and also providing abundantly for the mischievous effect of frost, by securing a lake of water under it, and the consequence of its erroneous formation will be great unnecessary expense.

In case of the adoption of any measures for sending persons from the United States to this country for instruction, they should be carefully selected from those who have had no opportunities of imbibing previous notions, or ima-

gining that they have any knowledge of the work they are sent to learn.

I have the honor to be, sir, your most obedient servant, Jno. Loudon M'Adam.

On Dry-Rot—its Causes, &c. By Robert Mudie, author of "Modern Athens," "The British Naturalist," "Attic Fragments," and many other works of utility published in England.

"Well, what is this dry-rot? '*Xylostroma giganteum*, which grows in the timber like a thick, broad patch of dull yellow leather, or *serpula distruens*, in other instances, which is smaller, redder in the color, and whitish at the edge, but that last is as often found upon other timber as upon oak.' Well, that is not a point worthy of much dispute; the timber is destroyed, and, generally speaking, these (the *Xylostroma* and *serpula*) are fungi: but it is just about as sensible to call these fungi 'dry-rot' as it would be to call flowing blood 'a wound,' or the worms that consume the body 'death!' Why come the fungi there? There was a time when dry-rot was unknown; and as long as the beams of houses were of good oak, or chesnut, or red pine from the north of Europe, there was no information laid against serpula. Besides, there never appeared a single fungus of any species upon or near the piece of oak in the experiment, and yet it passed from what may be regarded as the best state that it could be in for duration, to absolute uselessness, in so short a time that, if a ship were to decay as fast, the whole freight that could be obtained would not pay for the trenails. How is the same dry-rot to be got rid of? 'Oh, wash the timbers with sulphate of iron, and other saline solutions, and let the ship, or the house, as it may be, be well ventilated.' The old story—'Call in the doctor, apply a lotion, and exhibit a bolus,' under which the diseased have continued to die ever since medicine was a science. Are ships kept less clean now than they were before the dry-rot was heard of? or are they or houses worse ventilated? Truly not. If there be any difference, the ships must be kept sweeter, else the chlorides, and other powerful fumigations, have been invented and applied to little purpose. The crews certainly keep their health better than they did formerly; and it would be somewhat wonderful, if air, which were more wholesome for human beings, should be more deadly for oak timber! As for the houses again: there are certainly more under-ground apartments than there were once, and possibly more than it is wise to have. It may happen, too, that the tax upon windows has impaired the ventilation by those apertures; but in many of the modern houses, and those especially where the rot appears, the loss of ventilation by windows has been more than made up in ventilation by walls, many of which are so thin, and of materials so infirm, that, in as far as air is concerned, the fabric is ventilator all over."

"But fungi, by what names soever they may be called, are not locomotive destroyers; they do not, full grown, career over the land and the waters, to prey upon sound timber, as hawks do to prey upon birds, or wolves to prey upon sheep. The *sporæ*, or whatever else the small and generally invisible germs of the fungus may be called, are perfectly passive, and of themselves can do no more harm to an oak beam than could be done by a mustard-seed. The soil, in which alone it can germinate, or *begin* its action, is rotted wood. If it meet with that it will germinate; if not, it will remain inactive. There is no doubt that the increasing quantity of rotted timber has increased the number of those plants; but that has in no way altered the law of their nature, which is to grow in rotten wood, but not in wood which is sound. The only rational view of the case, therefore, is that the timber must be rotten before the fungus can act even in the slightest degree; and that, consequently, the fungus is produced by the rot, and not the rot by the fungus; and though the fungus is destroyed, the rot will go on probably as fast as if the fungus were not there; only, as the fungus has a great attraction for moisture, and as moisture, though not the cause, is an instrument in producing the rot, the fungus may, when it appears, hasten the destruction."

"Imported oak has been blamed for this decay; and it is true that the imported oak, and more especially the oak imported from America, is inferior to the oak which *once* grew in the forests of England. But the deterioration is not confined to the imported oak; and however bad that may be, it could not inoculate the oaks of the forest with its deleterious qualities any more than the species of insect called American blight, which infests apple trees, could take its departure for Hereford or Devon immediately on the landing of a cargo of American apples at

Liverpool. The rot is in the timber itself—*that* is of an inferior quality; and the cause why it has been allowed to degenerate is, that they by whom oak trees have been bred have not been careful in the observation of nature, but have proceeded in their operations by means that had no natural foundation. The object of the grower has been to get goodly trees—trees that pleased the eye, without any regard to the quality of the timber; and the object of the nurseryman has been to rear up his seedlings and get them to market as soon and in as showy a condition as possible.

"It has been said that the wrong oak has been cultivated, and that may be true; for the very same circumstances which led to the wrong mode of treatment may have led to the using of the wrong plant. The collector of acorns would naturally proceed upon the joint principles of 'the most easily obtained and the most saleable.' I do not know that it is in all cases a positive fact, that the worst kinds of oak are the most prolific of acorns; but it is a sort of generally observed law among vegetables, that where there is a great deal of fruit, the wood is soft and perishable: and that has reason on its side. Trees do not work miracles any more than men do; and, therefore, if its action is more turned in any particular direction, it must be less in any other. Fruit trees are often killed *in the wood* by excessive bearing; and, therefore, it is natural to suppose that a similar excess must injure the wood of an oak. Now, it generally happens that, in the same species, whether in the same or in different varieties of the same species, the productions run largest when they are most numerous. Hence the acorns of the oak having the inferior timber are the most profitable for the gatherer, both to gather and to sell; and those two circumstances are quite sufficient to bring them to the market in preference to and even exclusive of the other—more especially as the purchaser is to grow seedlings, and not oak timber. The question of the timber is, indeed, a question *seventy years hence* with those who deal in acorns and seedling oaks, and as they have small chance of hearing any complaint that may be made about the quality, they of course give themselves very little concern about it.

"Now, if people have been able to cultivate animals into greater size and strength and beauty, and also to make them have better flesh and finer wool—if they have been able to improve by culture the beauty of flowers, and the nourishing qualities of all manner of esculent roots, stems, leaves, and fruits—it would be passing strange if their culture could do nothing for an oak tree, but make it more worthless timber. If all the earth were given to man for improvement, and he had improved much of it—as he actually has done—it would be a perfect anomaly, if timber, which is so very useful, should be the single article on which he could not lay his hand of culture without doing it an injury. It is impossible to believe that such an anomaly can exist in nature—and, therefore, the only way is to catechise the man who makes the attempt; and, if he does not understand what he is doing, send him back to nature to inform himself as to what he should do.

"There is a custom, and a very inveterate custom, which we have, and that is, the custom of generalising analogies. If there be a way in which one thing answers very well with us, we are apt to think that same way will do as well in all other things, even though the things are, in their nature, quite different. We go about to persuade ourselves that the way of doing one thing is the way of doing every thing, just as Lord Peter, in Swift's 'Tale of a Tub,' went about to persuade his two brothers, Martin and Jack, that the brown loaf was beef, and mutton, and venison, and custard; and as we are always very willing to believe ourselves, we are far more ready believers than Lord Peter's brothers.

"Now, in all our cultivations of vegetables, there is none, save that of timber trees, in which the quality of the wood is any consideration; and there is, perhaps, none of them in which the wood is not actually deteriorated by the culture. In the grain plants that is decidedly the case. Straw is very inferior to hay in strength, in flavor, and in every quality. The more highly, too, that the grain plant is cultivated, and the more abundantly it produces seeds—the grand object of the culture—the straw is always the worse. In the cold districts, where the crops of stunted oats are barely worth the gathering in, and would not be worth it at all in a place where labor is high, the straw is rich and sugary, whereas the straw of barley or wheat, grown upon land in high condition, is perfectly insipid. The former, too, is tough and firm, the latter soft and brit-

tle, with little or no substance in it of any kind.

"It is the same with all the plants. One object is to obtain a certain part of the plant more abundantly and in higher perfection than it exists naturally, and we can obtain that only at the expense of the other parts. Compare a crab-stick with a similar portion of an apple tree, a hazle twig with one of filbert, a blackthorn with a plum, (if any or all of these be respectively the wild plant and the cultivated of the same species,) and see how inferior the wood of the cultivated tree is to that of the other. 'The wild wood' is just as superior in life as it is in strength. We have difficulty in keeping the cultivated plants 'rooted in,' and we have as much in getting the wild ones 'rooted out.' A very little observation of nature, and a few very simple reflections on that observation, might have shown us that that must have been the case; and had we taken that trouble, and very small trouble it is, we should never have gone about to cultivate timber in one plant by the process whereby we destroy timber in all other plants. Yet we have done, and we continue to do that; for, grafting excepted, we breed oaks and peaches in the same ground, and much after the same manner. We may make some difference in the mould in which they grow; or we may choose that which we fancy will be the best for each; but we do not even that as observers of nature, at least as very attentive or close observers—for our good soil for oak is that on which we have seen large oaks growing, whether the timber of those oaks happened to be good or bad."

Mr. Mudie then proceeds to inquire how nature proceeds in the production of one of the old "hundred year oaks":

"When the acorns are sown by nature, they are sown *on* the surface, not under it. The sprout tends downwards, as if to reach the ground, while the acorn lies on its side upon the surface; though even then the little tubercle which is to become the tree keeps its apex upwards. It is evident, therefore, that that part of the process is *naturally* done in the air; and, though seeds are better to have the light excluded during what may be called the 'fermentative' part of the process of germination, which is the earliest stage of it, yet, in the case of the acorn, that is over before the shell is ruptured.

"Now it is very much to be suspected that it is at this early stage that the mischief is done; and I am the more inclined to that opinion from the fact that the practical men seem to know very little about the process of germination, even in those seeds which they are sowing by thousands, nay, millions, every year—there is not much, indeed, in the professed writers on Vegetable Physiology. The agency of light was not understood in the days of Grew and Malphigi; and though that agency be better understood now, there has not been *very much* added to the other branch of the science. Besides, the buried acorn does appear to make some sort of effort to come to the surface, and when it is there the cotyledons acquire a greenish tinge, which they do not acquire when buried; and that clearly shows that, in their *natural* state, they give to the food with which they supply the young plant some of that preparation which vegetable matter receives from the action of light. The condition of all blanched and etiolated plants, compared with that of the very same species freely exposed to the air, clearly shows that *carbon and astringency*, the very things in which the perishable oak timber is deficient, are among the principal results of the operation of light. These additions appear to hinder rather than to forward mere growth at the time—for an etiolated potato will rise thirty feet in the dark, whereas it would not rise so many inches if exposed to the light; but, in the case of timber, there is a gain in consolidation, and that is the main point.

"The way in which the parts of the oak 'come' farther shows the importance of light to it at the very instant the plumule begins to move. By that time the root has penetrated to a considerable depth, and is furnished with absorbent rootlets. The nourishment which these procure cannot be acted on by the light in them, and the plumule, being just beginning to move, has no leaves, so that, if the cotyledons are buried in the earth, the oak must begin life with all the weakness of an etiolated plant; and if it begins without the carbon and astringency that are necessary for good oak timber, the timber of it must be bad, how long soever it may stand, or what size soever it may attain. Future treatment may make it grow faster or slower; but no future treatment can change the character with which it starts. If it starts good timber, it may be stunted or deformed, but it will be

durable; and if it starts bad timber, it may be showy, but it can never be good."

"Want of the proper action of light at 'starting' is not the only injury which timber trees sustain, by the way in which they are grown for the market. They are sown so close, that, while they remain in the seed-beds, they want both air and light. A seed-bed of pines, in the early stage of their growth, resembles a plat of moss more than any thing else: and when it is considered that, in the situation where they are native, the pines stand singly, and are exposed on all sides to the action of very keen air, it must easily be seen that they cannot acquire their due strength when huddled together to the number of many hundreds on a square foot. Those who are familiar with pine forests, or pine plantations, must be aware that the seeds of the cones never germinate under the thick shade of the trees, and grow up so as to form an underwood in the forest. Cones in abundance are produced every season, but they contribute chiefly to the food of the animal inhabitants, and it is only where a blank occurs, from the decay or the casual destruction of a tree, that young plants rise to fill it up. There are, indeed, few or no trees, of which the young plants grow and form underwood, while the old ones remain filling the air above; nor would it be in accordance with our general observation of nature, if they did. The young of no tribe, vegetable or animal, are the destroyers of the old; they merely come on, in succession, when they are required, and though the germs of all are exceedingly numerous, so that there never is room on a fit soil at the proper season without the plant appearing to fill it. But man comes in with his nursery-bed; and though he cannot be said to overstock the country (for there can hardly be too many trees—and there are numerous and wide wastes in England, where it is disgraceful that there are not millions,) yet the nursery-bed is overstocked, and the consequence is, the dry-rot in oak, and general rottenness and want of strength in all timber."

"The commercial advantages of having nurseries for forest trees, as well as other plants, near great towns, are so many, and so much, more obvious than the injuries that may thus be done to the trees, that many of them are in very tainted atmospheres. Ground there is high rented, and the plants are in consequence huddled together as closely as possible, both in the seed-beds and after they are transplanted. Still with the rich soil and skilful management in such places, the trees rush up quickly and look well, so that they are more 'taking to the eye,' and so fetch higher prices, than if they were to produce better timber. Indeed those plants, inferior as their timber must be, are actually the most acceptable to the immediate planter. Most species of forest trees are so long in coming to maturity, that the grand incentive to the planting of them is ornament and not use. Even the man who accumulates for posterity, in reality seldom does so in his own feelings of the matter; for he who leaves the most to others when he quits the world, did not collect it for them, but for himself—for the gratification of his desire of possession. The man who plants wishes to have something to look at, and to have it as speedily as possible, and that, with the other circumstances that have been noticed, conspires to cover the rich districts of the country with growing rubbish, which, when it comes to be cut down, is fit only for fire-wood, and very inferior for that."

[*From the Baltimore American.*]

Fire Proof Roofs.—Messrs. Editors: Will some one of your numerous subscribers, acquainted in the premises, inform me, and, through me, the public, what is the original cost of a slate roof of given dimensions, and, particularly, a comparison of the result with the cost of a pin shingle roof of corresponding dimensions. Also, how long these different kinds of roofs will last respectively, supposing no extraordinary accident occur to either. The object of these inquiries has relation to a measure now but partially agitated, of vital importance to the security of our city from fire. If a slate roof costs but a trifle more than a shingle one, and answers all its purposes, and in a series of years is a great saving, to say nothing of the reduction of the premium on policies of insurance in such cases, there cannot be a doubt that our City Council, now in session, will inquire into the expediency of passing an ordinance forbidding the use of combustible roofs within certain limits in the city of Baltimore.

A communication from an experienced fireman on the subject would also be gratifying to the public. As the City Council will not be in session long, an early answer to the above in-

quiries is expedient, and the writer hopes that no one, taking an interest in this matter and competent to do what is indicated in the interrogatories, will delay what is asked, upon the vulgar but too true maxim of experience, "that what is every body's business is no body's business. A PROPERTY HOLDER.

[We shall have great pleasure in inserting a reply to the above from any of our readers acquainted with the subject.—ED. M. M.]

New-York Patent Guard Rail. Communicated by the Inventor. [From the American Railroad Journal.]

The newly invented METALIC RAIL, for railroads, called the "*New-York Patent Guard Rail,*" for which the Patent right has been secured in the United States and in Europe. The Guard Rail is constructed on an entirely new principle, being, by *combination* in the process of manufacture, of *two kinds* of metal, namely, wrought iron and cast iron; so applied, that *each rail* combines within itself the principle of an *arch:* consequently they can be made of any required strength. Guard Rails of six, eight, or ten feet in length, resting their ends only on sleepers, may be made to sustain safely even ten or twenty tons to the wheel, if necessary, and remain fit for use, even if the *cast iron part* of the rail should, from any cause, become cracked in many places: they are *already made* in this city of eight feet in length, upon which ten tons have been applied, without affecting the rail; whereas *two and a half tons* to the *wheel* are probably as great a weight as will ordinarily be required upon railroads.

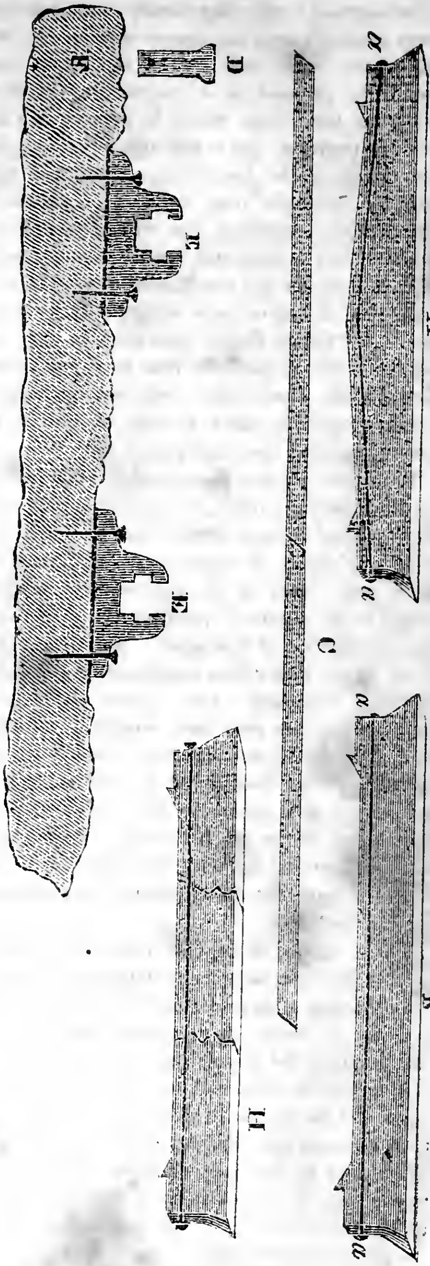
REFERENCES.

A and B represent side views, with the upper edge of rails of cast metal, with a wrought iron rod incased from end to end, and riveted at each end as at *a a.* (Rails on this principle may be made of any required form, and the annexed are not made by scale, but merely with a view to represent the combination of wrought and cast metal, as hereafter described.)

C is intended to represent the upper edge of two rails with bevel joints.

D, sectional view of the rail.

E E represent a sectional view of cast iron *chairs,* as secured upon wood or stone cross sleepers; the ends of the rails to rest in the chairs are to have corresponding notches, so as to receive keys applied horizontally.



F represents a rough wood or stone cross sleeper, squared only at spaces sufficiently large to fit the chairs E E.

H. With a view to illustrate the *principle* of the *arch* more clearly, the rail at H represents a rail with the *cast iron* part *cracked* at the lines

drawn across it, showing clearly that if a *weight* were applied upon the *upper* edge of the rail, the *cracks* in the *cast* iron at the *upper* edge would be pressed in a *contracting position*, while the *lower* edge would be pressed in a *distending* position ; yet it will appear evident that the cracks in the lower edge could not open until the *wrought iron rod* at foot should be drawn apart endwise : the wrought iron rod, being riveted at each end, secures the segments of cast iron, on the same principle as an arch composed of segments is secured by its abutments. "Guard Rails," however, in use, containing a rod of *malleable* iron from end to end, through the *lower edge*, will not be liable to crack, even with much greater weight than is usually applied upon railroads.

Rails made on this principle have been examined by many scientific gentlemen, among whom were several eminent Engineers, and approved of by all of them. A remark by one of those Engineers was, "that in his opinion this discovery would be the means of producing a revolution in the construction of railroads." An eminent Professor in this city, whose opinion of its merits was solicited, remarked "that it was decidedly the best rail that has ever been invented." I allude to those remarks as resulting from a particular *examination of rails in full size for use* by those gentlemen, as it seems difficult in writing a brief description to be so sufficiently explicit as to cause a clear and full understanding of it by persons who have not an opportunity of examining the rail itself.

I have alluded to the fact, that *each* rail made on this principle becomes within itself secured on the *principle* of an *arch :* as, for instance, the upper edge of the rail in principle forms the arch—the *wrought* rod being in the *lower* edge of the rail, extending from end to end, and *riveted* at each end, forms, as it were, the abutments, so that a *weight* upon the top of the rail would have a tendency to force the particles composing the upper edge of the rail in a *contracting* position, and a tendency to force the particles composing the *lower* edge of the rail in a distending position, so that, if a rail were to break, it becomes evident that the fissure must commence at the *lower* edge of the rail ; and it is also evident, that no fissure can commence in the lower edge without first drawing the *wrought* iron rod apart *endwise ;* and if a wrought iron *rod*, of say one inch in diameter, be applied, of good iron, it will require a distending force of some thirty or fifty tons to draw it apart. In some instances I have had a *small* rod applied in the *upper edge* of the rail : it, however, does not add to the main strength of the rail; it has the effect merely of keeping the sections of cast iron in place, if from any cause the cast iron part of the rail should become cracked, as rails made on this principle may be *retained in use* even after the *cast iron* part of the rail becomes *cracked* in many places; the *segments* of cast iron being secured at foot by the *wrought iron rod*, on the same principle that the segments of an arch are secured by its abutments. (See Plate annexed.) I have rails with the cast iron part purposely cracked in several places, merely with a view of testing their relative strength in that respect. (See Plate, letter **H.**)

Permanency : The *wrought iron* part of the Guard Rail being incased in *cast* iron cannot become weakened by corrosion, and experience has proved that *cast iron* is not greatly affected by exposure ; therefore there is probably no good reason for supposing, but that rails made on this principle will last fifty or even a hundred years, or more.

Saving of Capital : The saving of capital will greatly depend on the *length* of the rail used. It may be used of sufficient length to save the expense of *one-half* or *two-thirds* of the usual number of foundations or *sleepers.* This part of the saving, therefore, may be calculated on that principle, depending on the cost of sleepers in different situations ; and as a further advantage, when *dispensing* with so great a proportion of foundations or sleepers, railroads can be completed and rendered productive in a proportionally less time. Rails may be made on this principle requiring sleepers, say, *six* to *ten* feet apart.

I have already alluded to rails now cast in this city of eight feet in length, upon which ten tons were applied at a single bearing without affecting the rail : these rails weighed twenty pounds to the running foot ; they may, however, be made of sufficient strength with less weight of metal ; and from the fact that cast iron in England is only £4 per ton, it is presumed that rails can be procured in England at about £5 10 per ton of 2240 pounds, and can with necessary fastenings be imported free of duty.

The fact last alluded to is a very important one in relation to large investments of capital in rails ; these rails, imported free of duty, will at all times have an *intrinsic* value, even if broken up,

of a *profit on their original cost;* whereas rails, which are in their nature of decaying substances, after process of decay, sink the capital originally invested in them.

Use in Winter: These Guard Rails, being secured in cast iron chairs, may be elevated, the upper edge several inches above the surface, so that by the use of a snow plough, to pass upon the edge of the rail, they may be used in winter as well as in summer.

Use in Streets of Cities: These Guard Rails may be so applied in the streets of cities as to place the *upper* surface of the rail on a *line* with the paving stones; so that carriages and carts can *turn* upon them, and pass over them, without any obstruction whatever; *and further,* inasmuch as these rails require *cross sleepers* at distances only of six or eight feet, excavations may be made in streets, beneath the rails, for the *laying* or *repairing* of *gas* and *water* pipes, without injury to the railroad.

Wood Sleepers: It being that *wood* is not rapid in decay, if placed entirely beneath the surface, it may, in situations where stone are not easily procured, be used with great advantage, and degree of permanency; inasmuch as the chairs, when intended for wood sleepers, can be formed with so increased an elevation as to permit the wood sleepers to be placed *entirely below* the surface; and as such sleepers are to be applied *crosswise* the road, merely for the ends of the rails to rest upon, they may be applied in their original round state, except a small spot on the upper side, at each end, to be squared sufficiently large to fit the chairs upon, as represented at E E in the plate.

It having been matter of doubt whether cast iron chairs, so called, could be imported free of duty, I addressed a letter to the Hon. the Secretary of the Treasury, making an inquiry upon that point, and received an answer, from which the following quotation is an extract: "In reply I have to state that it has been decided that *cast iron chairs or pedestals,* with necessary fastenings for placing the iron rails thereon, are entitled to the benefit of the act of the 14th July, 1832, respecting railroad iron."

Lateral Pressure: In the construction of "Guard Rails," special care has been taken to guard against the effects of lateral pressure, which is *satisfactorily accomplished,* as will fully appear on examination of rails now made in full size for use.

Paper Carpets.—Paper carpets are formed by cutting out and sewing together pieces of linen, cotton, Scotch gauze, canvass, or any similar material, &c., to the size and form required; then stretching the prepared cloth on the floor of a large room, and carefully pasting it round the margins so as to keep it strained right. If cotton be the material, it will require to be previously wetted. When the cloth thus fixed is dry, lay on it two or more coats of strong paper, breaking joint, and finish with colored or hanging paper, according to fancy. Centre or corner pieces, cut out of remnants of papers, which may be bought for a mere trifle, may be laid on the self-colored ground, and the whole surrounded by a border; or any other method adopted which may suit the taste or circumstances of the occupier, or accord with the other furniture of the room. When the carpet is thus prepared, and quite dry, it should receive two coats of glue, or size made from the shreds of skins, such as is used by carvers and gilders. This size should be put on as warm as possible, and care should be taken that no part of the carpet should be left untouched by it, otherwise the varnish to be afterwards laid on will sink into the paper and spoil it. When the size is perfectly dry, the carpet should have one or more coats of boiled oil; and when that is dry, a coat of copal or any other varnish. The varnish is not absolutely essential, as boiled oil has been found to answer very well without it: but where oil only is used, it requires several more coats to be applied, and takes a much longer time to dry. These carpets are portable, and will roll up with about the same ease as oil cloth. They are very durable, are easily cleaned, and, if made of well chosen patterns, have a very handsome appearance.—[Encyclopædia of Cottage, &c. Architecture.]

A Garden of Bijous. By Flora Brumal. [From the American Gardener's Magazine.]

Mr. Editor,—The following communication is from the pen of a lady. An article published in the New-England Farmer, which I now send, contains a little play of fancy on the same subject. If your columns are not likely to be crowded with matter more appropriate to the present gay and animated season, please republish the article after the one now sent. A. W.

Conversing a few days since with a friend who is an enthusiastic admirer of nature in ge-

neral, and of a garden in particular, I was struck with his description of the effect produced in his own garden on a night comparatively mild and humid, succeeding a day of snow, sunshine, and frost. His outline of a picture pleased my fancy, and in an hour of idleness I have endeavored to read the pleasing impression produced upon my imagination by the scenes he described.

Accompany me then in a fancied ramble through an Hyperborean garden, and instead of the desolate wilderness of yesterday, you will find every branch, every tendril, pendant with precious looking gems, from the pale diamond to the deeply blushing ruby; and all in vegetable form, leaf, branch, bed, and flower.

The place of the rose, usurped by its own encrusted berry, furnished us with the semi-transparent cornelian, while the fair Missouri snow-drop (escaped from the general wreck of all that is beautiful) in its new crystal envelope gives us the faint hue of the sapphire.

There too you will find the noble and capricious opal, sheltered, yet illuminated, by the thousand hanging prisms which play around it, giving all the variety and fabled succession of colors attributed to that gem. Nor is the relief of foliage wanting in this parterre of brilliants, since every leaf of the perennial box and laurel forms an emerald of exquisite and indescribable beauty.

Let us penetrate every nook and alley of this enchanted garden, where every thing above, around, beneath, is fantastical, rich and elegant. The paths are embossed with pebbles of nameless hue,—the mountain ash, with its broad sheets of scarlet berries, yielding a perfect imitation of masses of coral.

The stately fir, in its clear, cold vestment, presents itself as a tree of the aqua marina, or sea-green beryl. Music and motion, too, lend their aid to complete the illusion: every breath of heaven, agitating the heavy laden branches, teems with the sweet sounds of silver bells, scattering millions of adamantine drops on the paths before us.

Sometimes our progress is obstructed by long wavy wreaths, that fear no enemy but warmth. Now may we gather for our friends bouquets of clustering rubies from the sanguine berries of the nightshade.

Well might the sublime author of the seasons exclaim—

"Nature, great Parent, whose unceasing hand
Rolls round the seasons of the changeful year,
How mighty, how majestic are thy works!
With what a pleasing awe they swell the soul
That sees astonished, and astonished sings."

Yonder hangs a solitary egg-plum, which, in spite of sun, shower, and storm, has hung tenaciously to its native bough, now filled, encased, and transformed by an irresistible element, it may vie with the famous Brazilian diamond of the house of Braganza.

A little further a bunch of withered purple grapes, swelled into rotundity, and burnished by the same all-pervading genius, boldly represents the glowing amethyst, which a Plutarch tells us has its name from its color, and is "wine mixed with water."

And can we leave this enchanting scene without gleaning some lesson of instruction? Is it not truly and delightfully said, "There are books in the brooks, sermons in streams, and God in every thing." May we not compare the few lingering relics of the garden, which have escaped the efforts of the burning sun and the severity of the winter's blast, to the remains of virtuous principle, which neither the warmth of prosperity nor the chill of adversity have been able to destroy.

If then even the caprices of nature yield us a useful lesson, how inexcusable are those who have neither an ear nor an eye for its constant admonitions, who suffer the most extensive and the only gratuitous library of useful knowledge to remain unread. Shall I venture to call it that splendid annual, published by its mighty author for nearly six thousand years, every page of which furnishes an inimitable picture of human life, and every line of which presents us an idea and a moral.

The study of nature leads to nature's God. The most ambitious literary aspirant can reach no higher. FLORA BRUMAL.

THE GARDEN.

Lansingburg, December, 1832.

One of the most interesting spectacles ever witnessed in the garden at this dreary season, (when Nature has stripped vegetation of its glories, and consigned her lovely offspring to their season's repose,) was noticed the early part of this month. A light fall of snow had been suddenly melted by the power of the sun's rays, whilst the thermometer was below the point of freezing. The consequence of this conflict between the two contending pow-

ers of heat and cold was that the whole remains of the vegetable tribe were suddenly converted into a mass of shining crystalization. Every tree, every shrub, and every ornamental fixture, were all in the space of a few hours completely enveloped in an icy coat of mail, of the most dazzling transparency, which during two days defied the power of the solar beam.

A group of weeping trees particularly attracted attention; whilst gazing on their pendant slender branches loaded with the purest icicles, the imagination was led to the classic recollection of the weeping deities, whom Ovid described as being converted into trees, and their tears into amber. They might indeed be called the tears of nature on the stern appearance of winter; and yet as the sunbeams elegantly danced among the branches, reflected from every spray, she seemed to be smiling through her tears.—The three-thorned locust exhibited its spikes in dazzling array. The crimson fruit of the barberry appeared like a cornelian enclosed in a diamond. The blackberry of the prim, the delicate snowberry, and the large roan tree berries, were peculiarly beautiful, whilst the humble box and the modest wintergreen had their color heightened by their case of crystal, more than equalling them in beauty. But how soon, how very soon, are these frail fabrics seen to melt away, and involve in their desolation so many gems.

The garden scene so lovely induced a stroll to a neighboring forest. There all was found chilling and unearthly: nature had dressed the whole woods as if for her own amusement—all was awfully grand and impressive. The idea occurred that the whole surface of the earth had been deadened by the paralyzing touch of winter. In the attempt to explore the woods the progress was slow through the brush wood—the branches neither yielding nor resisting, but snapping asunder on a moderate pressure, scattering fragments of crystal in all directions.

What a grand subject for the pencil! Every object around had received its portion of decoration. The very fences and stones were tastefully festooned and fringed, assuming a very picturesque appearance. Such a scene as this induces the reflection that if winter has its horrors, it has its beauties too;

> "Let Winter come with stormy voice,
> Let snow-wreaths crown the highest hill;
> He bids thee in the storm rejoice;
> He sees, protects, and feeds thee still."

Specification of Mr. Scrivenor's Patent for Improvements in the Construction of Iron Railways. [From the London Repertory of Patent Inventions.]

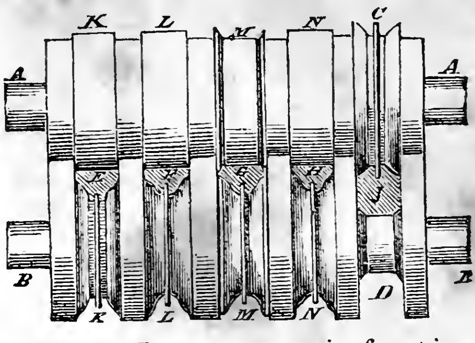


Fig. 1. A B represents a pair of cast-iron rolls or rollers, which must be mounted in proper frames or bearings as usual in iron works; these said rollers must have a series of grooves or mendations in their peripheries corresponding with the several shapes which the metal is intended to take in its progress through these rollers, until it at length attains the exact shape to form the chairs or pedestals. Thus, for example, the grooves at C D must be adapted to receive an ordinary short thick bar of wrought iron, say about two feet long and about six inches square, properly heated for rolling, and, in fact, of a size adapted for these said grooves, all which is well understood by persons accustomed to roll iron.

The bar is first passed through the rollers at C D, which causes it to assume the shape shown at J. It is then passed in succession through the other grooves on the rollers at KK, LL, MM, and NN, whereby it successively takes the forms shown at E, F, G, and H. Having thus obtained a long bar of iron, of the form shown in section H, I next proceed to cut it into lengths for chairs, which I perform by means of a pair of mill shears, shown at fig. 2; these shears may be worked

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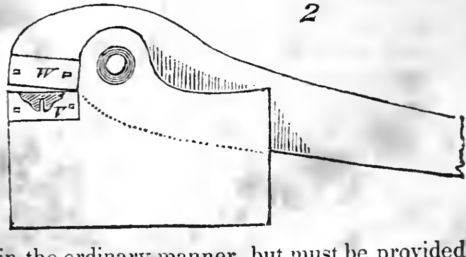
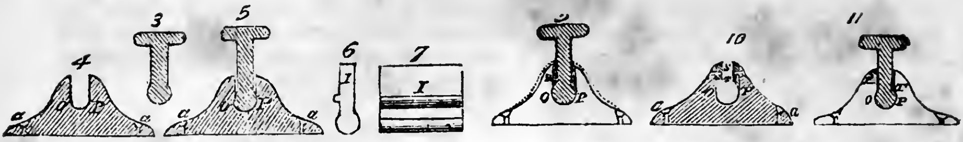
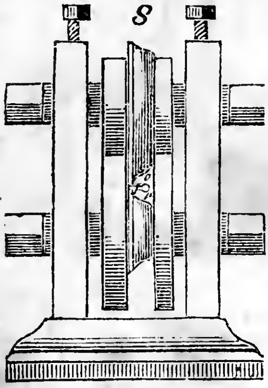
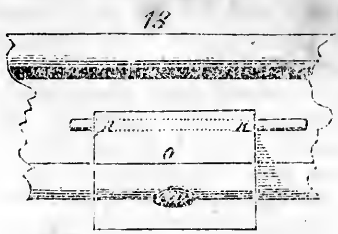
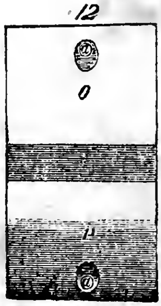


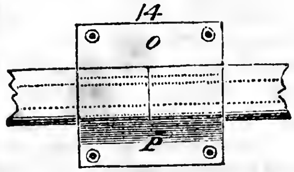
in the ordinary manner, but must be provided with steelings or jaws to receive the chair,

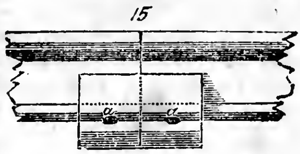












as shown at VW, otherwise the action of the shears in cutting off the lengths would be apt to force the chair out of shape. It may be here as well to observe, that as the form of the chair would necessarily vary to suit the form of the rail to be used with it, and it would lead to an unnecessary variety of shapes if I did not take one as a standard, for the purpose of describing my invention, I have selected that form of rail which I believe to be one of the most approved and most generally in modern use, and need only state that chairs may be made of wrought iron, on the same principle which I am now describing, to suit any of the ordinary forms of rail now in use; but for the purposes of this specification I shall confine my description to the form of chair required for the form of rail shown in section at fig. 3.

Having, in manner hereinbefore described, cut the rolled bar into proper lengths for chairs, they will assume the form shown at fig. 4, which is a transverse section, *aa* being the holes for the spikes or fastenings which hold it to the block or support; and I next proceed to shape the cheeks OP, more accurately to fit the under side of the rails, which if placed in the chair in its present state would have the appearance shown at fig. 5, and would be too unsteady for their purpose. In order to effect this, and to form at the same time a proper recess in the cheek O, for the wedge or key, which is used to wedge or key up the ends of the rails tight in the chair, I make use of a cold wrought or cast iron mandrel, as shown at figs. 6 and 7, in the following manner: Having heated the chair again in the furnace, I place the mandrel between the cheeks, OP, of the chair, and present it with the mandrel in it to pass through another pair of rollers, as shown at fig. 8, which rollers press the cheeks OP close upon the mandrel, I; and when the chair leaves these rollers it is complete; and if the mandrel be withdrawn, and the rail now inserted in it, will have the appearance shown at fig. 9, being the recess or aperture into which the wedge or key is to be driven to fix the rails firmly and steadily in their places. The dotted lines in this figure show the alteration in form which the chair has experienced by passing through the rollers shown at fig. 8.

Fig. 10 represents a wrought iron chair, made of more than one piece, and in this chair the cheeks of the chair are made to fit the rail by rivetting pieces of iron rolled to the proper shapes, to the cheeks of the chairs, after they leave the rollers at NN, fig. 1, in which case they will not require to be passed through the rollers shown at fig. 8. Fig. 10, which is now under description, represents a chair in the state in which it is left by the

action of the rollers at NN, fig. 1, and as shown at fig. 4, the cheeks O P having plane sides, or being parallel to each other. This fig. 10 exhibits a section of the chair, in which S T represent pieces of rolled iron firmly secured to the insides of the cheeks O P, by rivetting, as aforesaid.

Fig. 11 exhibits it in this latter state, with a wrought iron placed within it, and secured firmly by means of an iron wedge or key, driven tightly underneath the overhanging piece S, and pressing upon the shoulder of the rail at Q. This plan of wrought iron chair will be found useful when the lower part of the rail for which it is intended may be of any shape, differing from the ordinary kind.

Fig. 12 is a plan of a chair of the full size, and fig. 13 a side view of it with part of a rail placed in it: and fig. 14 is the plan, and fig. 15 the elevation, of another and broader chair, calculated to receive the ends of two rails, and to hold them more firmly than the narrower one shown before.

Now, whereas I claim as my invention the substitution of wrought or malleable in the place of cast iron, in the construction of those parts of iron railways called chairs or pedestals, whether the same be made in one single piece or of separate pieces, rivetted, or otherwise fastened together as hereinbefore described; and such, my invention, being to the best of my knowledge and belief entirely new, I claim the exclusive right and privilege to my said invention.

In witness whereof, &c. &c.

On the Stomach Pump—Method of dislodging Poison from the Stomach without it, &c. By Dr. Arnott.

A small pump, called the *stomach pump*, has lately been used in medical practice, for removing poisons from the stomach in cases where the action of vomiting could not be excited. It has already saved many lives. It resembles the common small syringe, except that there are two apertures near the end, instead of one, which, owing to valves in them, opening different ways, become what are called a *sucking* and a *forcing* passage. When the object is to extract from the stomach, the pump is worked while its sucking orifice is in connection with an elastic tube passed into the stomach, and the discharged matter escapes by the *forcing* orifice. When it is desired, on the contrary, to throw cleansing water, or other liquid, into the stomach, the connection of the apertures and the tubes is reserved.

As a pump may not be always procurable when the occasion for it arises, the profession should be aware that in many cases a simple tube will answer the purpose as well, if not better. Such a tube being introduced, and the body of the patient being so placed that the tube forms a downward channel from the stomach, all fluid matter will escape from the stomach by the tube, as water escapes from a funnel by its pipe; and if the outer end of the tube be kept immersed in liquid, there will be during the discharge a syphon action of considerable force. On then changing the posture of the body, water may be poured in through the tube to wash the stomach, and may by the same channel be again discharged. Such a tube, made long enough, might, if desired, be rendered a complete bent syphon, the necessary preliminary suction being produced by a syringe, or by the mouth of an assistant, acting through an intervening vessel.

But there is a still easier mode than either of these now described, of dislodging poison from a torpid stomach, *viz.* merely to place the patient so that the mouth shall be considerably lower than the stomach,—as when the body lies across a chair or on a sofa, with the face near the floor,—and then, if necessary, to press on the stomach with the hand. The cardiac orifice opens readily in such a case, and the stomach is inverted like any other inverted vessel.

Useful as the pump may prove upon occasions, in evacuating the stomach, its more ancient office of injecting the enema is still the more important, and recent experience seems to show that such injection may become a remedy of more extensive utility than had yet been suspected. From an erroneous opinion, that what had been called the *valve of the cœcum* acts as a perfect valve, allowing passage downwards only, few practitioners have ventured to order much liquid to be injected, for fear of overstretching the lower part of the intestine; and the possibility of thus relieving, by injection, disease situated above the supposed valve, has scarcely been contemplated. It is now ascertained, however, that fluid may be safely thrown in, even until it reach the stomach. Perhaps few, if any, cases of obstruction of bowels could resist the gentle force of penetrating water, so that a mechanical remedy of certain effect may, in many cases, be substituted for the drastic purgatives and pernicious bleedings

now used, and often used in vain. From what has been said above of the abdomen and the intestinal canal, it appears that an injection tends to spread itself with singular uniformity over the whole. This tendency may be rendered obvious to sight, by throwing a sheep's intestine, recently extracted, into a bucket of water, and then pumping water in at one end: a stream will issue strongly at the other end, although several feet distant, almost immediately, and without any intermediate part having become very sensibly tense. Of course, in the living body, in cases of spasm or obstruction, the liquid must be thrown in against resistance very gradually.

That case is called *introsusception* of the bowel, in which an upper portion falls, or is received into a portion below,—as one part of the finger of a glove may be received into another part,—and the receiving portion of the bowel, mistaking the received for descending food, holds it fast. This occurrence forms a complete obstruction, and generally proves fatal. Many infants, with irritable bowels, die of it. Now, a copious enema, such as we have described above, is almost a certain cure. The liquid advances until it reaches the part where the portion of gut has been swallowed by gut below; and as it cannot pass without pushing the introsuscepted portion back to liberty, it effects the cure.*

Attraction.—By *attraction* we mean the tendency that bodies have to approach each other. And first, in elucidation of this subject, if you throw a stone, or shoot an arrow into the air, instead of proceeding according to the direction in which you send it, you see its course is quickly spent, and it returns to the earth with a velocity or swiftness proportioned to its bulk or weight. Now, it is easy to conceive that the resistance of the air may stop it in its progress: but why should it return? Why should not the resistance of the air stop or impede it in its return?

The answer you will think very plain—it is its *weight* that brings it back to the earth, you will say, and it falls because it is a heavy body. But what is weight—or why is it heavy? It is, in truth, the earth that draws or *attracts* the stone or the arrow towards it; this overcomes the force with which you sent it from you at first, and the resistance which the air would otherwise make to its falling.

To make this plainer, if you drop a little water, or any other liquid, on a table, and place upon the liquid a piece of loaf sugar, you will see the water or fluid ascend, or in vulgar language, be sucked up into the pores of the sugar: that is, the one attracted by the other. Again, if you take two leaden bullets, and pare a piece off the side of each, and make the surface, where you have taken off the piece, exceedingly smooth, and then press the two balls together, you will find them adhere strongly together, that is, they are mutually attracted by each other.

If you take a piece of sealing wax, or amber, with a smooth surface, and rub it pretty quickly upon your woollen stocking till it gets warm, you will find that if straws, feathers, hairs, or any very light bodies, are brought within the distance of from an inch to half an inch of it, these light bodies will be drawn to the sealing-wax or amber, and will adhere to it. Thus, in philosophical language, they are attracted by it.

This last effect is very similar to what may be observed of the magnet or loadstone, or what is often performed by the little artificial magnets, which are commonly sold, and which afford a very rational and pretty amusement to young persons.

But what is a still more surprising effect of attraction, if we take two phial bottles, which we number 1 and 2, and fill each of them with a fluid perfectly colorless, we see they appear like clear water: on mixing them together, we will observe the mixture becomes perfectly black. We take another phial, No. 3, which contains also a colorless fluid, and we pour it into this black liquor, which again becomes, we see, perfectly clear, except a little sediment which remains at bottom. Lastly, we take the phial, No. 4, containing also a liquid clear like water, and by adding a little of it, the black color we see is restored.

All this appears like magic, but it is nothing more than the effect of attraction. Philosophy keeps no secrets, and we will explain it. The colorless liquor in the phial No. 1 is water, in which bruised galls have been steeped or infused; that in No. 2 is a *solution of copperas* (called by chemists *sal martis*, salt of steel,) in plain terms, it is water in which common copperas, or green vitriol, is

* It should be remarked, however, that this can succeed only whilst the introsusception is recent. After a time inflammation occurs, and adhesions form between the introsuscepted portion and the portion of bowel in which it is received.

dissolved. The iron which this salt (green vitriol) contains has a strong attraction for the gall water, and when they are mixed together they unite, and the mixture becomes black; in fact, is made into ink. But when the phial No. 3, which contains aqua fortis, (or the nitrous acid, as it is called by the chemists,) is poured in, the iron, which has a stronger attraction for it than for the galls, unites with it, and having left the galls, the liquid is again clear.

Again, the phial No. 4 contains salt of wormwood, in a fluid state, which the chemists call an *alkali*. The aqua fortis is nitrous acid, therefore, has a stronger attraction for this alkaline matter than it has for the iron; it therefore drops the iron, which again unites with the matter of the galls, and you see the fluid resume its black complextion. These several kinds of attractions, which we have now mentioned, philosophers have arranged under five distinct heads. The *first*, that we mean of the stone or the arrow falling to the ground, they have called the attraction of *gravity*, or gravitation.

The second, that of the two leaden balls adhering together, and of the water ascending into the pores of the sugar, they call the attraction of *cohesion*, and also capillary attraction. The third is *electrical* attraction, because the sealing wax, when chafed or warmed by rubbing against your stocking, is in an electrified or excited state, like the glass cylinder of an electrical machine when rubbed against the cushion, and therefore attracts the hair, feathers, &c. The fourth is the *magnetic* attraction; and the fifth is called *chemical* attraction, or the attraction of combination, because upon it many of the processes and experiments in chemistry depend; and because by this means most of the combinations which we observe in salts, the ores of metals, and other mineral bodies, are effected.

On the two first of these species of attraction only we shall at present enlarge, because it will be necessary to treat of the others when we come to investigate those branches of science to which they properly belong.

First, therefore, of gravitation. It requires no experiment to show the attraction of gravity; for since the earth is in the form of a globe, it is manifest that it must be endued with a power of attraction to keep upon its surface the various bodies which exist there, without their being hurled away into the immensity of space in the course of its rotary diurnal (or daily) motion. The earth has, therefore, been compared to a large magnet, which attracts all smaller bodies towards its centre. This is the true cause of *weight* or *gravity* (which mean the same thing.) All bodies are drawn towards the earth by the force of its attraction, and this attraction is exerted in proportion to the quantity of solid matter which any body contains. Thus, when two bodies are placed in opposite scales, and we see one preponderate, we say it is heavier than the other; in fact, that it contains a greater quantity of solid matter: for as every particle of matter is attracted by the earth, the greater number of such particles any body contains, the more forcibly it will be attracted. We know, by experience, that the *weight* or *gravity* of a body or thing is not in proportion to its bulk. A bullet of lead, of the same size as one of wood, or of cork, will weigh infinitely heavier, and one of gold would be heavier still. It is reasonable, therefore, to suppose that the ball of gold, or of lead, contains a greater number of solid particles, which are united or pressed closer together than those of the wood or cork, which is more porous, and its particles lie less closely compressed or compacted together. This, then, is what is meant by *specific gravity*, that one body contains more solid particles within a certain compass, size, bulk, or space, than another.

It is one of the laws of nature, discovered by Newton, and now received by all philosophers, that every particle of matter gravitates towards every other particle: which law is the main principle in the Newtonian philosophy. The planets and comets all gravitate towards the sun, and towards each other, as well as the sun towards them, and that in proportion to the quantity of matter in each.

All terrestrial bodies tend towards a point which is either accurately, or very nearly the centre of the earth; consequently, bodies fall every where perpendicular to its surface and therefore on opposite sides in opposite directions. As it acts upon all bodies in proportion to their quantities of matter, it is this attractive force that constitutes the weight of bodies.

The cause of gravity is totally unknown. Many theories have been invented to account for it, but they have been all mere hypothesis or conjecture, without any solid foundation.

II. The *attraction of cohesion* is observable in almost every natural object, since in reality it is that which holds their parts

gether. It has been already demonstrated, in the experiment of the two leaden balls, and the same effect will be proved by pressing together the smooth surfaces of two pieces of looking-glass, particularly if a little moisture is dropped between them to exclude the air more perfectly. The adhesion or tenacity of all bodies is supposed to depend on the degree of this attraction which exists between their particles; and the cohesive power of several solid substances has been ascertained by a course of experiments, in which it was to put to the test what weight a piece of each body of one tenth of an inch diameter would sustain, and the weights were found to be as follows:

Raw flax, .	37 lbs.	Ash, . .	50 lbs.
Horse hair,	45	Zinc, . .	18
Raw hemp,	46	Lead, . .	$29\frac{1}{4}$
Raw silk, .	$53\frac{1}{2}$	Tin, . . .	$40\frac{1}{2}$
Fir wood, .	23	Copper, .	299
Elm, . .	35	Brass, . .	360
Alder, . .	40	Silver, . .	370
Oak, . .	48	Iron, . .	450
Beech, . .	50	Gold, . .	500

This cohesion is also visible even in fluid substances, the particles of which adhere together, though with a less degree of tenacity than solid bodies. "The pearly dew" is a well known phrase in poetical language, and the drops of rain, or of dew, upon the leaves of plants, assume this round or pearly appearance by the attraction which the particles have for one another. In the same manner quicksilver, if divided into the smallest grains, will appear round, like small shot, because the particles attract each other equally in every direction, and thus each particle draws others to it on every side, as far as its power extends. For the same reason, two small drops of quicksilver, when brought near to each other, will seem to run together and unite.

Some bodies, however, in certain circumstances, appear to possess a power the reverse of attraction; and this is called in philosophical language, *repulsion*.

Blasting Rocks under Water.—Three men are employed in a diving-bell; one holds the jumper, or boring iron, which he keeps constantly turning; the other two strike alternately quick smart strokes with hammers. When the hole is bored of the requisite depth, a tin cartridge, filled with gunpowder, about two inches in diameter, and a foot in length, is inserted, and sand placed above it. To the top of the cartridge a tin pipe is soldered, having a brass screw at the upper end. The diving bell is then raised up slowly, and additional tin with brass screws are attached, until the pipes are about two feet above the surface of the water. The man who is to fire the charge is placed in a boat close to the top of the tube, to the top of which a piece of cord is attached, which he holds in his left hand. Having in the boat a brasier, with small pieces of iron red hot, he drops one of them down the tube; this immediately ignites the powder, and blows up the rock. A small part of the tube next the cartridge is destroyed; but the greater part, which is held by the cord, is reserved for future service. The workmen in the boat experience no shock; the only effect is a violent ebullition of the water, arising from the explosion; but those who stand on the shore, and upon any part of the rock connected with those blowing up, feel a very strong concussion. The only difference between the mode of blasting rocks at Howth and at Plymouth is that, at the latter place, they connect the tin pipes by a cement of white lead. A certain depth of water is necessary for safety, which should not be less than from eight to ten feet.—[Repertory of Patent Inventions.]

Vitality of Insects.—If the head of a mammiferous quadruped, or of a bird, is cut off, the consequences of course are fatal. But the most dreadful wounds that imagination can figure, or cruelty inflict, have scarcely any destructive influence on the vital functions of many of the inferior creatures. Leeuwenhoeck had a mite which lived eleven weeks transfixed on a point for microscopical investigation. Vaillant caught a locust at the Cape of Good Hope, and after excavating the intestines, he filled the abdomen with cotton, and stuck a stout pin through the thorax, yet the feet and antennæ were in full play after the lapse of five months. In the beginning of November, Redi opened the skull of a land tortoise, and removed the entire brain. A fleshy integument was observed to form over the opening, and the animal lived six months. Spallanzani cut the heart out of three newts (in Scotland called *asks*,) which immediately took to flight, leapt, swam, and executed their usual functions for 48 hours. A decapitated beetle will advance over a table, and recognize a precipice on approaching the edge. Redi cut off the head of a tortoise, which survived

18 days. Colonel Pringle decapitated several libellulæ or dragon flies, one of which afterwards lived for four months, and another for six; and, which seems rather odd, he could never keep alive those with their heads on above a few days.—[Ency. Brit. new edit.]

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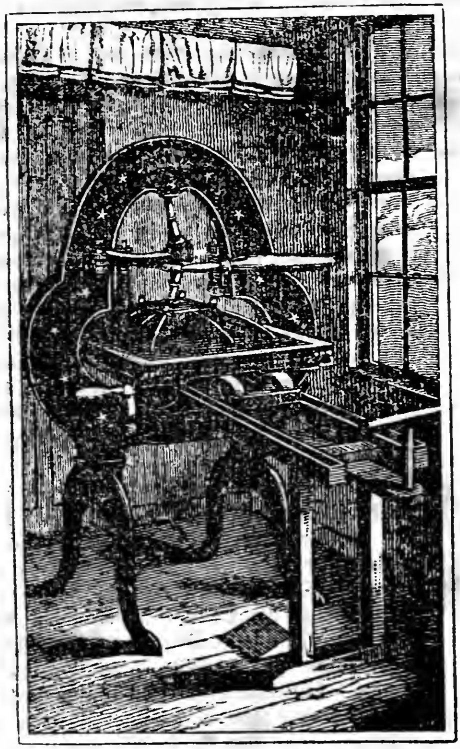


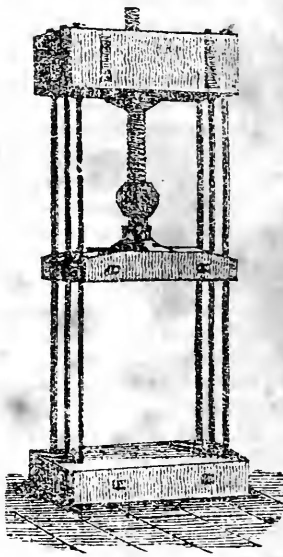
This press, manufactured by Messrs. R. Hoe & Co. of this city, is in great request by many of the printers in the United States, and deservedly so. As it is necessary, in order to get it conveyed to distant parts of the country, to send it in detached pieces, we here insert directions for putting it up:

It will be necessary to observe that all the connecting parts are marked or indented by points, which, if carefully observed, the press will be put together without difficulty.

After setting the frame upon its legs, and putting on the ribs and bed, lay the platen on the bed, between which two bearers should be laid about type-high. (The front end of the platen is marked F. T.) Then put the springs in their places, and the nuts over them, and pass the suspending rods through them, observing the numbers of indentations on them and the platen, on which they are to be screwed fast, so as to get them in their proper places. Give the nuts two or three turns, then screw the suspending rods fast to the platen, after which put in the bar-handle, wedge and knees; and also the wedge through the top of the frame, which regulates the impression. Then turn the nuts on the suspending rods, so as to compress the springs just enough to give the platen a quick retrograde motion; observing, at the same time, to get the surface of the platen parallel with the surface of the bed.

After having put the press together and levelled it, be particular not to raise the end of the ribs by the gallows, but let it go under rather loose, which will have a tendency to make the bed slide with more ease on the ribs.

PATENT STANDING PRESS.



The above Patent Standing Press is also manufactured by them; its construction is so simple that any description is unnecessary.

Novel Mode of preserving Human Remains.—M. Barruel, an eminent French chymist, boasts of being able to extract iron enough from the blood of a deceased person to strike a medal the size of a 40 franc piece. "He that hath the ashes of his friend," says Sir Thomas Brown, "hath an everlasting treasure." What would the learned author of the *Hydriotaphia* have said had he known the possibility of possessing iron relics?—[Medical Gazette.]

Self-Steering Ship. [From Elements of Physics, or Natural Philosophy, General and Medical.]

It is possible to make a ship or boat steer itself, by placing a powerful vane on the mast head, and connecting it with the tiller-ropes by two projecting arms from its axis. If it were desired to make the ship sail directly before the wind, the tiller-ropes would be fixed to the vane so that the helm should be in the middle position, when the vane were pointing directly forward; should the vessel then from any cause deviate from her course, the vane, by its changed position with respect to her, would have produced a corresponding change on the position of the helm, and just such as to bring her back to her course. Again, it is evident that, by adjusting such a vane and rudder to each other, in different ways, any other desired course might be obtained, and which would alter only with the wind. The vane would require to be of large size to have the necessary power—a wide hoop, for instance, with canvass stretched upon it; and the rudder, that it might turn with little force, would be hung on an axis passed through its middle, instead of, as usual, by hinges at one edge. Cases have occurred where shipwrecked persons might have sent intelligence of their disaster to a distant coast, by a small vessel, or even a block of wood, fitted up in this way; and the method might sometimes save an additional hand in a boat's crew. It admits also of other applications, particularly in war.

As fluids act on surfaces, in a direction perpendicular to them, the water on the right side of a ship's bow is always pressing towards the left side; but owing to the equivalent and contrary pressure there, the ship holds her course evenly between the two, or straight forwards. When a ship, however, owing to a side wind, lies over, or *heels*, as it is called, that side of the bow which sinks most is more pressed than the other; and were it not for a counteracting inclination of the rudder then made, constituting what is called *weather helm*, the ship's head would come round to the wind. Now, ships so rarely have the wind exactly astern, that, to diminish the almost constant necessity for weather helm, the mast or masts, and consequently the mass of the sails, are placed more towards the bow than the stern.

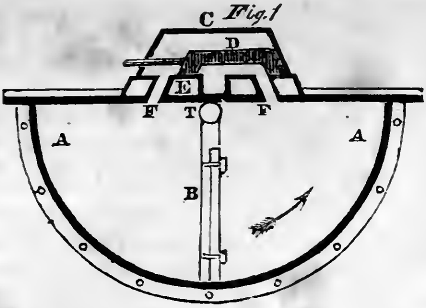
Again, because the bow of a ship is oblique downwards as well as sideways, the water, when she moves, is constantly tending to lift the bow; hence, when a vessel is dragged by a low horizontal rope, as in the case of a boat attached to a sailing ship's stern, or is moved by paddle-wheels, like steamboats, the bow rises much out of the water, and the stern sinks in the hollow or furrow of the track: but when she is driven by sails, as these are high on the mast, and are acting therefore on a long lever to depress the bow, the two opposing tendencies just balance each other, and the vessel sails evenly along.

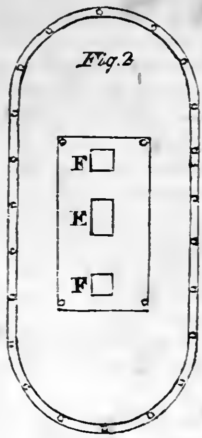
The form of the fore part of a ship has less influence upon her speed of sailing, than the form of the hind part from the middle to the stern, called the *run*. When a ship is at rest, there is of course as much forward pressure of water about the stern as of backward pressure on the bow; but when she sails, she is running away from the propelling pressure, and is increasing the resisting pressure. A gradual tapering of the hind part therefore, or a *fine run*, as it is called, which allows the water to apply itself readily to it, as it passes along, must quicken much the rate of sailing. A tree, or the tapering mast of a ship, can be drawn through the water the most easily with the large end foremost.

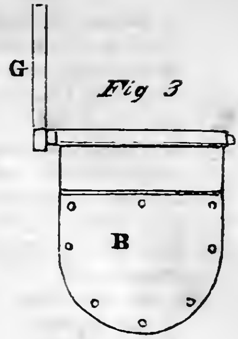
Improved Rotary Engine. By G. N. To the Editor of the Mechanics' Magazine.

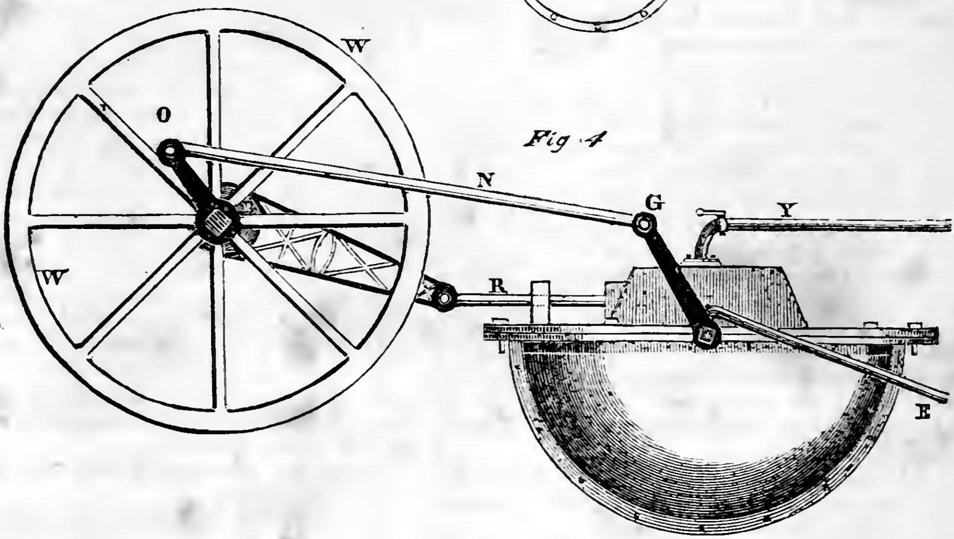
Sir,—In your last number I noticed a description of Ericsson's Rotary Engine, extracted from the London Mechanics' Magazine, the chief recommendation of which is its extreme compactness combined with its power. Hitherto Rotary Engines have met with poor success, and this has in a great measure been owing to the great friction which is necessary for preserving the piston tight, or, a want of surface for the steam to act upon. In a reciprocating engine, the constant distribution of power for moving the valves, and geering, necessary to communicate a reciprocating to a rotary motion, must amount to considerable. Now in Rotany Engines all this is avoided, and motion may be communicated to machinery without the slightest difficulty. Judging from the description, Ericsson's Engine has, however, one disadvantage, and that is the difficulty of construction.

Nothing is more requisite for the good performance of any machinery than simplicity and harmony in all its parts, and, the more simple the machine, the better is it made, and consequently the more successful. I give below a description of an Engine in-









vented, I believe, by a Mr. Mollery, of Oswego, which is even more compact than Ericsson's, and much more simple and easy to construct. The only one which I have ever seen was used for propelling a small boat called the "Water Witch," about the size of a common canal boat. She had two engines, one to each wheel, and these were of such dimensions that a man might easily carry one in each hand. And yet it worked rapidly and easy, moving the boat with considerable velocity—say, 10 miles an hour. The whole machinery occupied about a third of the boat.

EXPLANATION.

Fig. 1 represents a longitudinal section through the middle of the chamber A A. B is a piston or vane, moving on the axis T, packed in the usual manner. D, a slide moving in the steam box C. F F are pipes or holes for throwing the steam on the piston. E, the aperture for the exhaust.

Fig. 2 is a top view of the cap to the chamber, having the steam box taken off. F F, holes communicating with the interior of the chamber. E, exhaust hole.

Fig. 3 is a detached view of the piston; G is a bar for giving motion to the crank.

Fig. 4 is a side view of the engine, with all its parts. G is the bar meeting the rod N, which joins the crank at O. P is an eccentric for moving the slide. R, rod for the slide. E, exhaust pipe. Y, pipe for conveying steam from the boiler. W, balance wheel for equalizing the motion. The chamber being in two parts, is screwed together by nuts as shown in Fig. 4. It remains then only to show the manner of setting it to work. This is effected in the following manner—steam being admitted to the steam box

by means of the pipe Y, enters the open pipe F, (Fig. 1,) moving the vane to a horizontal position, in a direction with the arrow. The slide D is then moved by the eccentric, and the steam is thrown on the other side of the piston, moving it in a contrary direction to a horizontal position. In this manner a regular reciprocating motion is preserved, from which a rotary one is easily taken by means of a connecting rod and crank, as in Fig. 4. Yours, &c. G. N.

Geneva, April 3d, 1833.

List of English Patents granted between the 20th of January and the 21st of February, 1833.

John M'Curdy, of Southampton-row, for certain improvements in machinery for acquiring power in rivers and currents. Partly communicated by a foreigner. To enrol within six months from 22d of January.

Luke Hebert, of Paternoster-row, civil engineer, for certain improvements in machines or apparatus for, and in the process of, manufacturing bread from grain, and the application of other products for another product thereof to certain useful purposes. January 24; six months.

Robert Stephenson, of Newcastle-upon-Tyne, engineer, for certain improvements in the locomotive steam-engines now in use for the quick conveyance of passengers and goods upon edge-railways. Jan. 26; six months.

Edwin Appleby, of Doncaster, iron-founder, for certain improvements in steam-engines. Jan. 29; six months.

Josiah John Guest, of Dowlais Iron Works, Merthyr Tidvil, Esq., for an improvement in the process used for reducing iron ore, and other materials containing iron, to what is called in the iron trade finers. Jan. 31; four months.

Luke Hebert, of Hampstead-road, civil engineer, and James Don, of No. 9 Lower James-street, Golden-square, for certain improvements in engines, and other machinery employed in the construction of steam-vessels and steam-carriages, a portion of which improvements is applicable to other purposes. Part of which improvement was communicated by a foreigner. Feb. 21; six months.

Alexander Gordon, of the Strand, engineer, for certain improvements in the boilers or generators of steam or vapor, and in condensing such steam or vapor, and in engines to be worked by steam or vapor for propelling or actuating machinery and carriages on land, and boats or vessels or other floating bodies on water. Being a communication made to him by a certain foreigner. Feb. 21; six months.

Robert Hicks, of Wimpole-street, Middlesex, Esq., for an improved method of, and apparatus for, baking bread. Feb. 21; six months.

Method is the very hinge of business, and there is no method without punctuality. Punctuality promotes the peace and good temper of a family. The calmness of mind which it produces is another advantage of punctuality. A man without punctuality is always in a hurry: he has no time to speak to you, because he is going elsewhere; and when he gets there he is too late for his business, or he must hurry away to another before he can finish it. Punctuality gives weight to character: such a man has made an appointment; I know he will keep it: and this generates punctuality in those with whom he lives—for, like other virtues, it propagates itself. Servants and children must be punctual where the master is so. Appointments become debts. I have made an appointment with you; I owe you punctuality, and I have no right to throw away your time, even though I might my own.

Statistics of the Temperance Society.—Twenty-one State Temperance Societies are already formed.

There are more than 4,000 Societies in the United States.

More than 500,000 persons are pledged to total abstinence, and 1,500,000 practise it.

There are more than 600 vessels sailing out of our ports without ardent spirits.

More than 1,400 distilleries have been stopped.

Two hundred public houses have discontinued selling intoxicating liquor.

More than 4,000 merchants have given up the traffic in ardent spirits.

More than 45,000 drunkards have reformed.

There were in the United States 467,000 regular drunkards in the year 1828.

There were 15,000 persons excommunicated, annually, from the 12,000 churches in the United States, for intemperance.

There were in our cities and large towns about one grog-shop to every twelve families.

There are about 609 murders committed yearly in the United States that proceed directly from intemperance.

Twinkling of the Fixed Stars.—Having never yet seen any solution of the twinkling of the fixed stars, with which I could rest satisfied,* I shall offer the following, which may not perhaps be found an inadequate cause of that appearance; at least it has undoubtedly some share in producing it, especially in the smaller stars. It is not, I think, unreasonable to suppose that a single particle of light is sufficient to make a sensible impression upon the organs of sight. Upon this supposition, a very few particles of light, arriving at the eye in a second of time, will be sufficient to make an object visible, perhaps not more than three or four; for though the impression may be considered as momentary, yet the perception, occasioned by it, is of a much longer duration—this sufficiently appears from the well known experiment of a lighted body whirled round in a circle, which needs not make many revolutions in a second to appear as one continued ring of fire. Hence, then, it is not improbable that the number of the particles of light, which enter the eye in a second of time, even from Sirius himself, may not exceed three or four thousand; and from stars of the second magnitude, they may therefore not much exceed an hundred. Now, the apparent increase and diminution of the light which we observe in the twinkling of the stars, seems to be repeated at not very unequal intervals, perhaps about four or five times in a second: why may we not then suppose that the inequalities, which will naturally arise from the chance of the rays coming sometimes a little denser and sometimes a little rarer, in so small a number of them, as must fall upon the eye in the fourth or fifth part of a second, may be sufficient to account for this appearance? An addition of two or three particles of light, or perhaps of a single one upon twenty, especially if there be an equal deficiency out of the next twenty, would, I suppose, be very sensible; this seems at least probable from the very great difference in the appearance of stars, whose light is much less different than, I imagine, people are in general aware of; the light of the middlemost stars in the tail of the Great Bear does not, I think, exceed the light of the very small star next to it, in a greater proportion than that of about sixteen or twenty to one; and Bouger tells us in his *Traite d'Optique*, that he finds a difference in the light of objects of one part in sixty-six sufficiently distinguishable.

It will perhaps be objected, that the rays coming from Sirius are too numerous to admit of a sufficient inequality arising from the common effect of chance, so frequently as would be necessary to produce this effect, whatever might happen in respect to the smaller stars; but till we know what inequality is necessary to produce this effect, we can only guess at it either one way or the other; there is, however, another circumstance, that seems to concur in the twinkling of the stars, besides their brightness, and this is a change of color. Now the red and blue rays being very much fewer, I apprehend, than those of the intermediate color, and therefore much more liable to inequality from the common effect of chance, may help very much to account for this phenomenon, a small excess or defect in either of these making a very sensible difference in the color.

It will now naturally be asked, why the frequency of the changes of brightness should not be often much greater, as well as sometimes less, than that above-mentioned, and why the interval of the fourth or fifth, or some such part, should be pitched upon, rather than the fortieth or fiftieth part of a second, or than a whole second, &c.; for, according to the length or shortness of the time assumed, the changes that will naturally occur from the effect of chance will be smaller or greater in proportion to each other. The answer to this question will, I think, tend to render the above solution more probable, as well as to throw a good deal of light upon the whole subject. The lengths of the times then between the changes of brightness, if I am not mistaken, depend upon the duration of the perception before-mentioned, occasioned by the impression of the light upon the eye, than which they seem to be neither much longer nor shorter. Whatever inequalities fall within a much shorter time than the continuance of this perception, will necessarily be blended together, and have no effect, but as they compose a part of the whole mass; but those inequalities, which fall in such a manner as that they may be assigned to intervals nearly equal to, or something greater than, the continuance of this perception, will be so divided by the imagination, which will naturally

* Some astronomers have lately adopted, as a solution of this appearance, the extreme minuteness of the apparent diameters of the fixed stars, which, they suppose, must in consequence of this be intercepted by every little mote that floats in the air; but, that an object should be able to intercept a star from us, it must be large enough to exceed the apparent diameter of the pupil of the eye; so that, if the star were a mathematical point, it must still be equal in size to the pupil of the eye.

follow, and pick them out as they arise.—[Phil. Trans. 1767.]

Rice Paper.—The fine and beautiful tissue brought from China and Calcutta, and employed under the name of *rice paper*, is far from being an artificial substance fabricated from rice or any other farinaceous material. By holding a specimen of it between the eye and a clear light, it will be seen to consist of a vegetable tissue, composed of cellules so exactly similar, and so perfect, that no preparation of a paper could be possibly made to acquire.

It is now known to be made of the internal part of the *Œschynomene paludosa*, Roxburg,—a leguminous plant which grows abundantly on the marshy plains of Bengal, and on the borders of vast lakes between Calcutta and Hurdwart. It is a hardy plant, requiring much moisture for its perfect growth and duration. The stem rarely exceeds two inches in diameter, spreading extensively, but not rising to any great height.

The stems of this plant are brought in great quantities in Chinese junks, from the island of Formosa and other places, to China and Calcutta. These stems are cut into the lengths intended for the leaves or sheets, and then, by means of a very sharp and well tempered knife, about ten inches long and three inches wide, the pith is divided into thin circular plates, which, being pressed, furnish the leaves sold under the name of rice paper. The operation of cutting the leaves is very similar to that of cutting corks. The leaves are generally seven or eight inches long and five wide; some are even a foot long. Those which are not fit for drawing are colored for other purposes. Rice paper absorbs water, and swells so as to present an elevation, which continues after it becomes dry, and gives to the drawing a velvety appearance and a relief, which no other kind of paper produces.

Rice paper may, with care, be written upon, as the ink does not spread. The writing is glossy, showing some metallic surfaces.

Examined chemically, it seems to be analogous to the substance which Dr. John calls medulline. Treated with nitric acid, it forms oxalic acid.

The white and pure specimens are much used for drawings; the inferior are variously colored, and now extensively used in forming artificial flowers. In India, a pasteboard is made by cementing many leaves togethe[r] and of this hats are fabricated, which, co[v]ered with silk or other stuff, are firm an[d] extremely light.

Rice paper was introduced into Europ[e] about thirty years ago. The flowers whic[h] were first made of it sold at an exorbita[nt] price. A single bouquet cost the Prince[ss] Charlotte of Wales £70 sterling.

From the quality of this paper, it may b[e] most successfully employed in painting bu[t]terflies, flowers, birds, plants, and animal[s]. For this purpose, the object is first sketch[ed] on common paper, which is then to be past[ed] on a card. The sketch must be of a de[ep] black. On this the rice paper is fastene[d] and the painting effected with a pencil a[nd] fine colors. When executed in this way, [by] the most skilful hands, the pictures of butt[er]flies, insects, &c. have been often mistak[en] for the animal itself pasted on paper. Ri[ce] paper has also been employed in lithogr[a]phy, with the most brilliant effect.

It is desirable for the purposes of art, th[at] some aquatic plant should be found in o[ur] own climate whose pith is analogous to th[at] of the Œschynomene. Is it not possib[le] also, to fabricate a paper, the tissue of whi[ch] may absorb water, and furnish the rel[ief] which gives to rice paper its greatest valu[e]—[Jour. des Connais. Usuelles, Fev. 183[.]

Night and Day Telegraphs in Fran[ce].—A project has been laid before the Gove[rn]ment by a Company (Messrs. Ferrier a[nd] Co.,) for improving telegraphic commu[ni]cations to such an extent, that they will [be] able to transmit intelligence an imme[nse] distance at any moment of the night or da[y]. This plan is especially calculated for t[he] conveyance of commercial intelligence. [A] million of francs will be sufficient, accord[ing] to the Company's calculation, to establis[h a] full complement of telegraphs between Pa[ris] and the following places:—Havre, Cala[is], Lille, Maubeuge, Marseilles, Toulouse, B[or]deaux, and Nantes. The yearly expe[nses] they calculate at 900,000 francs, but [the] produce per annum would be 2,803,2[..] francs.—[London Times.]

Stocking Knitter.—The Lancaster, [..] Miscellany notices the invention of Mr. M[c]Mullen, of Huntingdon county, in that st[ate] of a machine of the above name. It is [de]scribed as being turned by a crank, and [re]quiring about as much power as a sm[all] hand organ. It is capable of perform[ing]

e work of six expert knitters, and adapted the knitting of wool, cotton or silk.

Heat and Light.—Innumerable operaons of nature proceed as regularly and as fectually in the absence of light as when it present. The want of that sense which it designed to affect in the animal economy no degree impairs the other powers of the dy, nor in man does such a defect interfere any way with the faculties of the mind. ght is, so to speak, an article rather of xury than of positive necessity. Nature pplies it, therefore,not in an unlimited abunnce, nor at all times and places, but rather th that thrift and economy which she is ont to observe in dispensing the objects of r pleasures, compared to those which are cessary to our being. But heat, on the ntrary, she has yielded in the most ununded plenteousness. Heat is every where esent. Every object that exists contains it quantity without known limit. The most rt and rude masses are pregnant with it. hatever we see, hear, smell, taste or feel, full of it. To its influence is due that ends variety of forms which are spread over d beautify the surface of the globe. Land, ter, air, could not for a single instance ist as they do, in its absence; all would ddenly fall into one rude formless mass— id and impenetrable. The air of heaven, rdening into a crust, would envelope the obe, and crush within an everlasting tomb that it contains. Heat is the parent and nurse of the endless beauties of organizan; the mineral, the vegetable, the animal ngdom are its offspring. Every natural ucture is either immediately produced by agency, maintained by its influence, or imately dependent on it. Withdraw heat, d instantly all life, motion, form, and uty, will cease to exist, and it may be erally said, "Chaos has come again."

Clothing, Natural and Artificial.— e covering of wool and feathers, which ture has provided for the inferior classes animals, has a property of conducting heat ry imperfectly; and hence it has the effect keeping the body cool in hot weather, and rm in cold weather. The heat which is oduced by powers provided in the animal onomy within the body, has a tendency, en in a cold atmosphere, to escape faster n it is generated; the covering being a n-conductor, intercepts it, and keeps it confined. Man is endowed with faculties which enable him to fabricate for himself covering similar to that with which nature has provided other animals. Clothes are generally composed of some light non-conducting substances, which protect the body from the inclement heat or cold of the external air. In summer, clothing keeps the body cool, and in winter warm. Woollen substances are worse conductors than those composed of cotton or linen. A flannel shirt more effectually intercepts heat than a linen or a cotton one; and whether in warm or in cold climates, attains the end of clothing more effectually.

If several pieces of cloth, of the same size and quality, but of different colors, black, blue, green, yellow, and white, be thrown on the surface of snow in clear daylight, but especially in sunshine, it will be found that the black cloth will quickly melt the snow beneath it, and sink downwards. The blue will do the same, but less rapidly; the green still less so; the yellow slightly; and the white not at all. We see, therefore, that the warmth or coolness of clothing depends as well on its color as its quality. A white dress, or one of a light color, will always be cooler than one of the same quality of a dark color, and especially so in clear weather, when there is much sunshine. A white and light color reflects heat copiously, and absorbs little, while a black and dark color absorbs copiously and reflects little. From this we see that experience has supplied the place of science in directing the choice of clothing. The use of light colors always prevail in summer, and that of dark colors in winter.

Valuable Material for Walks and Alleys.—A soap-maker not knowing what to do with the black sulphurous residuum of his ley tubs, spread it in a wet state along the alleys of his garden. It soon became stiff and almost impervious to rain; the alleys were always dry; no grass or weeds appeared on it, but the plants within a few inches of it all died. He was delighted with this discovery of the means of enjoying clean and dry walks without any trouble, having only to put a covering of clean sand over the refuse. Having occasion some time after to repave his yard, he used the soft refuse instead of mortar. It soon hardened and cemented the stones so well, that the heaviest carriages occasioned no disadjustment.—[Jour. des Connais. Usuelles.]

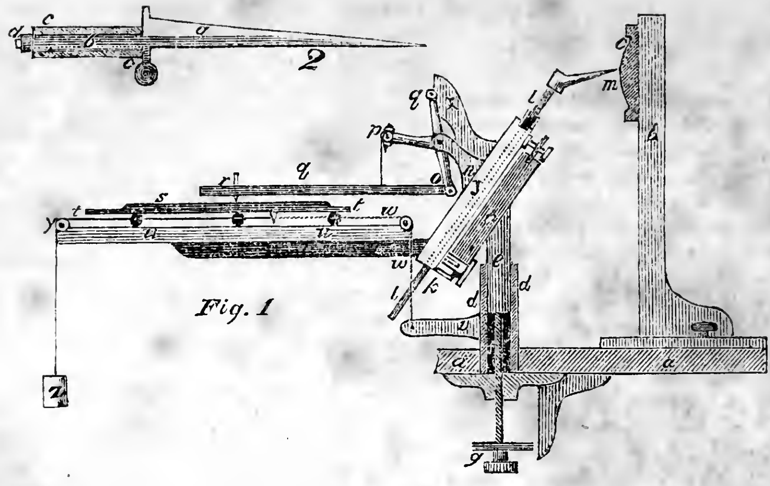


Fig. 1

The above is the engraving promised in our last, of the apparatus "for producing engravings of medals by machinery applied to the surface of the medal itself, or to that of the caste from it;" the description is by Mr. Hebert, Editor of the Register of Arts, and which we copy from the London Mechanics' Magazine. In our Analysis of the December number of that work, we omitted to state that the Editor had done ample justice to the claims America had to the invention, an oversight which we are glad to have an opportunity of rectifying.

"Fig 1—*a a* represents a portion of the table, to which is screwed a standard *b*, that receives the medal *c*, or other subject to be copied. To this table is also fixed a brass socket *d d*, in which a bolt *e*, fitted to it with great accuracy, is made to slide up and down by the agency of a fine threaded screw *f*, provided with a micrometer head at *g*, for the purpose of adjusting the motion through equal spaces. The vertical bolt *e* is surmounted by a strong plate or guide frame *h*, fixed to it in an inclined position; on the upper edge of this frame is a groove, in which run two or more rollers, or little conical edged wheels (as that seen at *i*), fixed to the under side of the upper part of a carriage *j*: this carriage has another roller at bottom, marked *k*, which runs upon a flat plate bolted to *h*. This carriage, made of brass, has a flat steel plate *l l* passed through it, with conical edges moving against anti-friction rollers, and to the upper edge of the steel plate is fixed the tracing point *m*, as will be hereafter more particularly described. *n* is a standard fixed to the tracer carriage, bearing a three-armed piece *o p q*; the lower extremity of the arm *o* being jointed to a bar, which carries the etching point *r* over the copper or steel plate *s*, lying on its carriage *t t*, running upon a metallic stage *u u*. *v* is a metallic arm fixed to the socket *d*, and connected by a steel chain *w w* to a stud *x* in the under side of the plate carriage; to this stud is also attached a silken cord passing over a pully at *y*, suspending the weight *z*: the province of this weight is to draw the carriage plate backwards, as the tracing point passes over the projections of the medal, while the chain *w* draws the carriage forward as the tracing point passes into the cavities. In cases where the descent into cavities is perpendicular, or nearly so, to the plane of the middle, neither the common conical point, nor the tapering blade *m*, will reach the required spot; to obviate this difficulty, the patentee has inserted a very ingenious tracer of the blade form (fig. 2).—*a* is the blade, having an axis *b*, with the centre of motion coincident with one straight edge of the blade, *c c c c* represent a socket, into which the pivot *b* of the blade fits with great accuracy, but made to turn with facility; the nut *d* keeps the tracer up to its bearing, to prevent its shaking longitudinally. It is evident that this form of tracer will admit of its being passed down the perpendicular sides of any declivity, in whatever direction the perpendicular side may be."

The Journal of the Franklin Institute, for September last, contains an elegant engraved portrait of William Congreve, the Dramatist, executed by Mr. A. Spencer, of Philadelphia, in the manner described, and has

inserted the following proofs that the invention can be claimed for America.

"Believing that the credit of the invention of a machine for medal ruling is due to America, we will briefly set forth our proofs, and then speak of the improvements which of late years the method has undergone.

"The proofs to be given of the existence and state of a machine are to be derived from the results produced by it.

"In 1817, by the use of a machine which had been invented in Philadelphia, Christian Gobrecht, die-sinker, produced upon copper an engraving from a medal, having upon it the head of Alexander of Russia: from this engraving impressions were taken and distributed. One of these impressions we have seen.

"In 1819, Asa Spencer (now of the firm of Draper, Underwood & Co. bank note engravers,) took with him to London a machine of the kind above alluded to, which was designed principally for straight and waved line ruling. This machine was used in London during the year just mentioned, and the mode of ruling waved lines, and of *copying medals,* was then exhibited and explained by Mr. Spencer to several artists; particularly to Mr. Turrell, who took, by permission, a drawing of the machine, for the purpose of having one made for his own use.

"Little, however, was done in the way of medal ruling until about three years since, when a desire to apply the method to the engravings of designs for bank notes caused it to be revived by Mr. Spencer, who bestowed great attention upon it, and overcame the difficulties met with in the outset.

"The peculiar construction of this machine has never been made a secret, nor has it ever been patented, although prudential motives have required that it should not be minutely described, and thus be placed in the hands of those by whom its use might be perverted. In consequence of this free communication in relation to this machine, it is now made, with modifications in the details, for engravers, by some of our machinists. We have lately had the pleasure of inspecting one of beautiful workmanship, made by Messrs. Tyler, Fletcher & Co.

"The operations performed by this machine are the ruling of parallel straight lines at any required distances apart, and either continuous or broken; ruling converging straight lines; ruling waved lines, the waves being either similar or varying by more or less imperceptible gradations; and medal ruling, or transferring to copper the fac-simile of a medal without injuring its surface, the waved lines presenting a copy of the minutest parts of the medal.

"Mr. Bate is said, in the extract which we have given, to be engaged in *perfecting* a machine for medal ruling: in his patent he claims the improvements on a machine for that purpose. It is impossible to say how far this latter claim may be borne out, since a description of the patented improvements has not yet reached us.

"That Mr. Spencer has essentially *perfected* this machine, as far as beauty of execution and fidelity of representation in the work to be done by it are concerned, we do not hesitate to say; and that the public here, and our brethren of England, may be enabled to judge for themselves, we have obtained from Mr. Spencer a specimen* of medal ruling executed with his machine, an impression from which we give.

"The engraving is made from a copper medal placed in an embossed card of the ordinary kind. The surface of the medal bears not the slightest trace of injury from the machine, and even the yielding surface of the card is not roughened by it.

"An impression taken thus from a plate gives but a faint idea of the exquisite effect produced by engravings themselves made by this machine upon a polished surface of gold or silver.

"A series of the Napoleon medals, together with a portion of the series of medals struck in commemoration of the events of the first French revolution, attest the skill of Mr. Spencer."

The Journal of the Franklin Institute observes truly, that

"America *has been* without her journals to put forth the claims of her ingenious men, and the credit of more than one invention has passed from her to those who have been able to give greater publicity to their designs; but this day has passed away, and we find notices of the ingenious works of our countrymen transferred to the pages of foreign journals, to be appreciated and acknowledged abroad as well as at home."

That need be no longer a cause of complaint, our pages are open to all communications that have utility for their object, and we invite communications from inventors and

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* "Various specimens of this work have been long since sent to London, and may be found in the possession of Messrs. Perkins and Heath, and of other artists."

practical men on all subjects relative to the Arts and Sciences.

History of Chemistry.—Chemistry, considered as an art, is of the earliest origin; but, considered as a *science*, it may be said to be of very modern date. The method of kindling *fires*, baking *bread*, moulding *clays* into various forms, extracting *metals* from their *ores*, and working them into different shapes, as well as several other chemical processes, were certainly known to the Antediluvians.

Tubal Cain, who is mentioned in Scripture, and whom the Pagans made their Vulcan, is the first person on record who knew any thing of this art.

It is said, "he was a worker in Iron and Brass:" he must, therefore, have known something of Chemistry before he could have extracted metals from their ores, and rendered them malleable.

It appears that, soon after the Deluge, the family of *Ham* made great progress in the Art: for the Egyptians, whose country is called Ham in Scripture, and who are said to be the descendants of *Ham*, applied themselves very much to this branch of study, and made many discoveries; such as embalming the bodies of the *dead*, making *Vases*, fabricating a kind of Nitre, making common Salt, and even *Wine;* and, it is said, they knew the art of distillation.

It was in Egypt that the famous Hermes Trismegistus lived, who has been regarded by many heathen nations as the inventor of *all* the arts. He is said to be the Author of all the learning of the Egyptians, and believed by many to have been Chanaan, son of Ham, or Abraham, or Joseph.

From this person the science of Chemistry derived the name of the *Hermetical Art;* a name which it was long known by, and is often called so in old books.

It was in Egypt that Moses learned the properties of Metals, the method of extracting Oils, the preparation of Gums and Perfumes, the solution of Gold, the dying of Linen, the art of Gilding, the making of Pottery, Soap, &c.

The Phœnicians were the first who applied themselves to the examination of the chemical effects of different bodies upon each other; and it is said the Grecians derived their arts which depend on chemical principles from the Phœnicians.

The Romans being mostly engaged in war, were not distinguished among the ancient nations for discoveries in the arts, or inventors in science. They, however, understood the art of making excellent *Wines* and *Spirits*, and knew the application of manures; and the remains of their works of Architecture evince the incomparable perfection of their cement.

But all the *Arts*, *Sciences*, and *Literature*, of the Greeks and Romans, were destined to sink into *oblivion.* Hosts of barbarian conquerors descended upon them from the North, and completely destroyed the principles of civilization, and gave a death-blow both to science and literature.

Driven as it were from Europe, the arts obtained an asylum among the Arabians. The attachment of this nation to magic, and their predilection for the marvellous, soon increased the mysteries in which the arts were then involved; hence Alchymy, or the art of transmuting the various metals into gold, took its rise. This happened about the beginning of the fourth century. As this delusive dream of the imagination held out a bait to avarice, it soon acquired a very numerous train of followers.

Those who professed this *Art* gradually assumed the form of a Sect, under the name of Alchymists: a term which is supposed to be merely the word Chemist with the Arabian article *al* prefixed.

The Alchymists laid it down as a first principle, that all metals are composed of the same ingredients; or, that the principles (at least) which compose gold *exist* in all *metals*, and were capable of being brought to a perfect state by purification.

The substance which possessed this wonderful property, they called *lapis philosophorum*, or the "Philosopher's Stone;" and many of them boasted that they were in possession of that grand instrument.

The fortunate few who were acquainted with the philosopher's stone, called themselves *adepti*, or adepts; that is, persons who had got possession of the secret.

This secret they pretended they were not at liberty to disclose, and that vengeance would fall on the man's head who should *venture* to publish it.

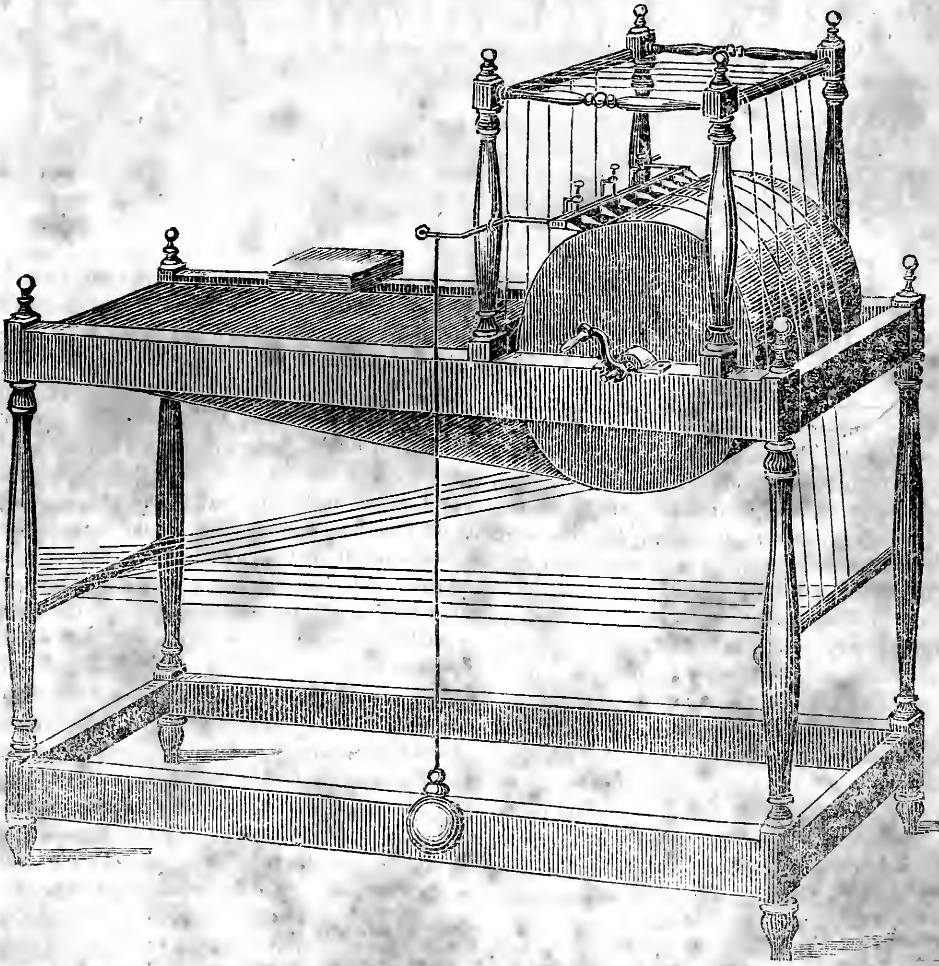
In consequence of these notions, the Alchymists kept themselves as private as possible; and concealed with the greatest care their *opinions*, their knowledge, and their pursuits.

The Alchymists seem to have been established in the West of Europe as early as the ninth century.

Between the *eleventh* and *fifteenth centuries*, Alchymy was in its most *flourishing* state. The writers who appeared during that period were very numerous; but their books are altogether unintelligible, and bear a strong resemblance to the reveries of madmen than the sober investigations of philosophers.

The principal Alchymists who flourished during the dark ages were Albertus Magnus, Roger Bacon, Raymond Lully, and the two Isaacs of Holland. It was against this sect that Erasmus directed his well known satire, entitled the Alchymist.

[*To be continued.*]



Mr. Bigelow's Paper Ruling Machine.—The above cut represents a very simple and compact machine for ruling paper for account books, invented and constructed by Mr. Bigelow, of Fulton street, Brooklyn, L. I., requiring but one person to work it. The paper is laid on by the left hand, and the crank turned by the right, and by means of an endless cloth is drawn towards the cylinder, and confined to it by endless cords. On the top of the cylinder are the pens, which, by means of the weight attached, can be made to press light or heavy, as may be required. The paper thus ruled passes round the cylinder, and by means of the endless cords is conveyed to a sufficient distance to enable the ink to dry when it drops on the pile.

Mr. Jno. S. Williams, Engineer and Superintendant of the Cincinnati, Columbus, and Wooster Turnpike Company, some time since undertook (gratuitously) to survey the route from Goshen to Columbus, with a view of as-

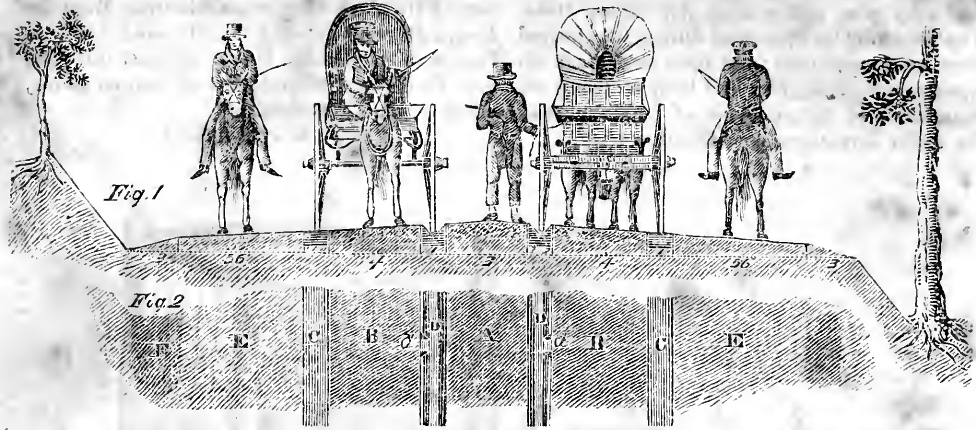


Fig. 3

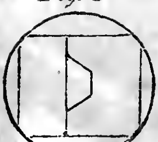
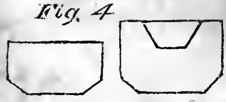


Fig. 4



certaining the best means of constructing a turnpike road thereon. A report has been made by him, and published by the board of directors, from which we learn that the estimated amount of forming a M'Adamized road the distance of 81 miles, would be an expense which Mr. W. doubts the propriety of incurring. Mr. W. enters into a detailed statement to show that wood can be substituted for stone in the improvement of roads, and gives instances, gathered from answers to interrogatories put to several engineers, of the durability of causeways so constructed, from which it appears that good timber laid in clay, and partly covered, will last from 20 to 30 years. From the estimates made by Mr. W. it appears that to cover a road with timber hewn a foot square and covered with earth, of 20 feet wide only, the expense would be $257,419 80. This plan also is considered too expensive, and Mr. W. inserts a proposition for a track road, constructed of timber (see plate), the advantages of which he thus describes:

"It becomes necessary to inquire in what way timber, which is so plenty, and appears to last well, can be disposed of to our advantage. My reflections upon this subject have brought me to believe that timber hewn flat and laid in ways or tracks lengthwise of the road, to bear the pressure of wheels, would insure the end desired. The method that I believe to be the best is to hew and lay four ways or tracks, two quite flat, say one foot on the face, and two furrowed or guttered so as to receive the near wheels of all waggons and carriages.

"These tracks ought to be laid about five feet apart from centre to centre. The gutter or furrow made to receive the near wheels of carriages should be about 3 inches deep, and say 4 inches flat in the bottom, the tops being 6 or 7 inches open. This would receive the wheels of all or most waggons. The centre of this track, laid say 5 feet from the centre of its fellow track, which is a foot on the face, would give such a diversity of width, that while the near wheel is kept in the furrow the off wheel would be on the other track, notwithstanding a small diversity in the width which exists between the wheels of different waggons.

"The face of the outer or off track should be laid on a level with the bottom of the furrow in the near or inner tracks, and the horse path should be gravelled or M'Adamized on a level with the face of the outer track, and rise gently across the horse path towards the near track for the purpose of draining, the depth of the furrow admitting of this circumstance.

"The two near tracks ought to be laid about four feet apart, from centre to centre, and gravelled or M'Adamized between them, for what I shall call the driver's path. This path would accommodate footmen, horsemen, and teamsters, or, if thought best, a horseman's path may be constructed on each side of the outer or off tracks. Four feet for the driver's path, and five feet each for the horse paths, together with six inches on each side for the surplus width of the outer tracks, make a total width

of fifteen feet from out to out of the two carriage ways; eight and a half feet on each side would be the width of summer road and ditch in a 33 feet graduation.

"For the purpose of draining, these tracks should be inclined not less than half a degree. In fact, no part of any M'Adamized road ought to be less. The near or guttered tracks might be changed for a few inches at the foot of the slopes from the guttered to the flat form without any inconvenience to the travel: this would form a side drain across the horse-paths. The outer tracks being flat would present no obstacle to draining.

"By carriages keeping always to the right, the power of this kind of road I conceive would be much greater than that of common roads, for more carriages could operate upon them without obstruction or danger, than if allowed to run promiscuously.

"As respects the ease of travelling, a road thus constructed being perfectly smooth and sidewise level, I conceive it would be superlative. It is observable, in the travelling of M'Adamized or other roads, that a great difficulty exists in keeping the wheels of waggons out of the ruts or furrows that wear, or accident has made in the road. There seems to be a propensity or habit in horses to follow each other, and consequently to run in the same track. In this order they are the most easily driven. This very propensity or habit of horses is a drawback of twenty per cent. upon the permanence of M'Adamized covers. It is our privilege, if not our duty, to turn if possible this propensity to our advantage: thus, in such a road as the one under consideration, little or no trouble would be necessary to keep the wheels steadily and regularly in the tracks. When snow would cover the road and thereby render the tracks obscure, the chances would be in favor of the road being frozen so as to bear in any part, and render the keeping of the tracks unnecessary.

"In case a carriage of speed should overtake one of burthen, it will be easy for it to mount over the driver's path and run in the left hand track until an opportunity appears for it to resume its proper one: the driver's path being raised but three inches.

"As to the lastingness of timber thus situated, I am of opinion it would be good. The earth or clay would completely envelope every stick its whole length, except the upper surface, by which its native juices would be completely extracted, particularly if the timber be large enough to cut through the heart. As to the capability of wood to sustain the travel for a great length of time, my experience in this particular is too limited to assert positively, but from what observations I have been able to make, I am of opinion that it would compare better with broken stone than might at first be imagined. The sides of the furrows in the near tracks would suffer abuse; but when we consider that they would be three inches thick at the top, and four at the bottom, and that as they would wear they would give more room, and thereby be less likely to wear, it is not unreasonable to conclude that good timber well laid, under an ordinary travel, would last on an average of fifteen years. The near tracks might not last more than ten, while the outer or off tracks would last twenty. There being little or no jolting, or even jarring, the great source of wear in common roads, the track-road would out-last all others, respect being had to the materials of construction.

"In regard to the cost of constructing, and the perpetuity of such a road, it may be well to observe that at present, on a great portion of the line, timber sufficient for the tracks abounds within 30 to 50 feet of the centre; a great portion of which must be removed before the line can be improved in any manner. On no part will timber have to be moved far from its native to its destined locality, and as regards perpetuity, the prospect is more favorable than that of M'Adamized roads in a country where lime-stone, the material of construction and repair, is barely sufficient for other branches of improvement, during this and coming ages. Good oak and other timber can at all times and forever be cultivated upon the sides of the road, rendering it at once beautiful, pleasantly shady, and perpetual: advantages by no means attending M'Adamized roads, which will forever continue to exhaust the present existing material without there being a possibility of a renewal. This would in future prove to be a serious disadvantage in districts of country but scantily supplied at present.

"The horse paths, the driver's path, and the summer roads, might be improved by laying upon them a coat of gravelly earth, which abounds in many parts of the country destitute of stone, and can be procured and laid at a very small cost,

"Gravelly earth will present an even and pleasant road to travel, if the weight of loaded wheels can be kept from it, as is witnessed on the tow-paths of our canals, where constructed of that material. But I would suggest that the horse and driver's paths be M'Adamized to the depth of six inches, which would be amply sufficient for any purposes for which it is intended: under this might be laid, say, six inches of gravelly earth, whenever it shall be found convenient. It might also be proper to gravel, say, five feet of each summer road, or at least construct the upper surface of them of the most solid earth in the neighborhood. The tracks may be laid of timber, round except the upper surface. It would, however, be better to form them of large, well grown timber, split or cut through the heart: the sides squared, so as to take off the bark and white-wood. These tracks may be of pieces any convenient length, with the ends brought to a determinate thickness, and laid upon a block placed to receive them. The under side of the tracks ought to be straightened or partly flattened, in order to secure a more steady position of them. The earth ought to be closely applied to the bottom and sides, not only to effect this object, but to secure a more speedy extraction of the acid from the wood. The limey quality transferred from M'Adamized horse and driver's paths to the wooden tracks, would be likely to prevent both wear and decay. Where the road is necessarily much curved, it ought to be M'Adamized, and the tracks dispensed with, particularly if good material is convenient, which is almost invariably the case, where your line is crooked. The line from Goshen to Columbus, as will be seen by the map, is laid almost entirely of long straight lines, not more than one mile and eighty-two poles requiring to be M'Adamized, and that where the stone is most plenty. Eighty miles of the line, therefore, is suitable for tracks, which ought first to be laid of squared timber, after which the two inner ones might be guttered or furrowed by machinery propelled by steam or animal power, and moved along the tracks simultaneously as the operation proceeds.

"The proposed method of improvement, if found to answer the purposes of traffic and travel, whether it shall last equal to the expectation of its inventor or not, will be found to be one of immense utility, by reason of the cheapness of its first construction, which brings the first cost of improvements, to a level with the scanty means of a country newly settled, and as it were yet in the wilderness."

Mr. Williams advocates, with much earnestness, internal improvements of every description: the report is well drawn up, and is of itself evidence that it has been done by a hand well acquainted with the subject upon which it treats. We think, however, that in speaking of the probable advantages to be derived from systems that he recommends, he is rather too sanguine of the result. We cannot do better than let Mr. W. speak for himself:

"Any state or nation that would adopt a general system of internal improvement by roads and canals would do away sectional jealousy. The interests of the different parts would become one by the common course of intercommunication. Inter-marriages would take place, and a general diffusion of acquaintanceship, and a union of interest would be the result. At the same time that wealth, the source of power, would be thus increased, power itself would follow its consequence of the system. The means of intercourse would give a facility to the transportation of men to defend the country, and stores to render those men comfortable; munitions of war, too, would reach every point to render formidable those forces, which with the greatest facility could be conveyed so as to render the effective force double to what the same means would be without it. This system would at once unite the citizens as if they inhabited but a small island, while at the same time they would be as strong as if they filled a vast territory."

Such a state of things is very desirable, and perhaps may occur, but we think it not likely in our time. Mr. W. concludes the report thus:

"The hand which guides this pen was among the first to fell the trees of the interminable territorial forest, to let the sun see the soil that now in the state of Ohio presents so many pleasing subjects for contemplation and reflection."

Affording another instance that, in a free country like this, industry and talent will always be duly appreciated, and in most cases amply rewarded.

[Since the above was in type we have received a communication from Mr. Williams, by which we learn that the Company have determined to construct eight miles of road on this plan.—Ed. Mec. Mag.]

Analysis of Scientific Periodicals for March.

The American Journal of Science and Arts. January, February, and March, (Quarterly.) New-Haven, H. Howe & Co.—This is a rich number. The article on Mr. Babbage's Economy of Machinery and Manufactures, (a very neat edition of this work has been recently published by Carey & Lea, Philadelphia,) displays great judgment. It will be read with interest by every lover of science, and the practical man will derive from it much useful information. It is, in fact, an epitome of Mr. Babbage's book, interspersed with numerous judicious remarks by the writer.

Mr. Thomson's description of *curves in arches*, with engravings, we purpose transferring to our columns in our next.

Mr. Phillips' article on the Georgia Gold Mines, (with numerous illustrations,) is full of interest, and, in truth, the whole number will bear comparison with any of the European journals. In mechanical execution, it surpasses many of them.

The Journal of the Franklin Institute contains short accounts of thirty-six American patent inventions, none of which are of much interest. Among them are five of patent medicines. With all due deference to the committee, we would suggest whether such matters had not better be left to the Medical Journal.

Under the signature of *Modern Antiques*, the claim of Mr. T. O. N. Ruthers, (in a communication to the Philosophical Magazine,) to the invention of a new *Oxy-Hydrogen Blow Pipe Apparatus*, is disputed. It is stated that the merit appears to be due to Dr. Hone, and an account of it was published in the same Journal 15 years ago.

The Repertory of Arts and Inventions, (London,) contains an account of a patent machine or motive power, for giving motion to machinery of different descriptions, to be called Hainsselm's Motive Power, principally by water, which we shall give in our next, with such of the engravings as may be necessary to illustrate the description. It cannot but be of great utility in this country, where so many opportunities present themselves of applying water power.

Mr. William Henry James, civil engineer, of Thavies Inn, has obtained a patent for improvements in steam carriages. He has constructed a new boiler, consisting of metal plates so thick as to retain heat, and thin enough to be portable. The plates are perforated in a variety of orifices like malting bricks, and by regular perforations are made to form continued tubes, when the separate sheets or plates of metal are laid together.

Another improvement is in the lantern: three elegant lamps are placed in the very foremost part of the engine, and are fed from reservoirs of portable gas.

Mr. James also claims, in his specification, the novelty of having *the Guard's Horn played by steam*. What next? "We shall," as the editor of the Repertory observes, "have an orchestra filled with steam fiddlers and fifers, and our machines will move to the measures of Mozart, or the wild rythm of Von Weber."

It appears that the engine must be very large, and the machinery very complex, and is one of those inventions which in theory appear very plausible, but are extremely difficult to put into practical operation.

Literary Gazette.—From it we learn that a committee of scientific gentlemen, whose names combine an array of talent, resolved to commemorate the anniversary of the 100th year of the birth of Priestley, by a public dinner, considering him entitled to the distinction, being the founder of Pneumatic Chemistry.

London Mechanics' Magazine.—In the February number, besides the description of Ballingall's improvements on ship building, [which will be found at page 162,] are several articles of interest and ability.

In the review of Mr. Alexander Gordon's "Journal of Elemental Locomotion," the editor attempts to amuse his readers with a description of what he is pleased to call "the Day Dreams of Mr. Gordon." Mr. Gordon, who we know is really a scientific and well informed man, contends for the practicability of applying steam power to travelling on common roads. The editor of the Mechanics' Magazine, on the contrary, says, "the thing is *impossible*—nature and *art* alike forbid it. No one, who is acquainted with the scientific principles on which the application of steam to travelling on common roads must depend for success, and who is free from all sinister interests, can view with the least pleasure or approbation an advocacy conceived in so *ignorant* and so visionary a spirit."

The attack on Dr. Birkbeck is quite as rancorous and as unjustifiable as most of the former ones have been from the same source. They certainly are, as far as the doctor is personally concerned, undeserved. No one has been a greater friend to mechanics' institutions than Dr. Birkbeck, and more especially to the one in London.

METEOROLOGICAL RECORD, KEPT IN THE CITY OF NEW-YORK.

From the 26th day of March to the 29th of April, 1833, inclusive.

[Communicated for the Mechanics' Magazine and Register of Inventions and Improvements.]

Date.	Hours.	Thermometer.	Barometer.	Winds.	Strength of Wind.	Clouds from what direction.	Weather and Remarks.
Tuesday, Mh.26	6 a. m.	36	29.78	WNW—NW	moderate	WSW	fair
	10	42	.85	NW	fresh	..	..
	2 p. m.	45	.86	..	..	..	..
	6	40	.92	..	..	..	..
	10	36	30.01	..			..
Wednesday, 27	6 a. m.	32	.05	..	moderate		clear
	10	44	.08		..		..
	2 p. m.	46	.02	SW			fair—hazy
	6	42	.02	..	..		hazy
	10	40	.01	..	..	SSW	..
Thursday, 28	6 a. m.	30	.10	NW by N	light		..
	10	40	.13	..	..	WSW brisk	..
	2 p. m.	43	.00	SW—NNW	moderate	..	..—cloudy and hazy
	6	41	29.97	N by W	..	..	fair
	10	37	.94	..	..	..	..
Friday, 29	6 a. m.	30	.89	NNW	light	..	..
	10	34	.91	..	..	..	..
	2 p. m.	45	.81	W—NW	moderate	..	..
	6	43	.81	NW		..	..
	10	40	.89	..	light	..	..
Saturday, 30	6 a. m.	36	.99	W	..		clear
	10	40	30.05	WNW	fresh		..
	2 p. m.	50	29.98	..	moderate		..
	6	48	30.02	..	..		..
	10	44	.09				..
Sunday, 31	6 a. m.	40	.16	SW	light		..
	10	50	.19	..	..		..
	2 p. m.	60	.09	SW by W	..		..
	6	55	.02	..	..		..
	10	50	.05	..	..		..
Monday, April 1	6 a. m.	43	.08	WSW	light		..
	10	50	.10	SW by W	faint		.. —moderately smoky, [or dry fog
	2 p. m.	66	.06	..	light		..
	6	60	.02	..	..		..
	10	54	.03	..	faint		..
Tuesday, 2	6 a. m.	45	.10	N—NNE	faint		clear—moderately smoky, [dry fog
	10	56	.15	NE—ESE	light		.. — ..
	2 p. m.	62	.12	ESE—SE by E	..	WSW	fair — ..
	6	56	.10	ESE	..	..	.. — ..
	10	50	.10	E	..	..	.. — ..
Wednesday, 3	6 a. m.	44	.09	NE—E	..	SSW	.. — ..
	10	48	.09	ESE—SSE	..—moderate	..	cloudy — ..
	2 p. m.	57	.01	SSE	moderate	SSW / SSE	..
	6	55	.00	..	..	.. / ..brisk	..—rain
	10	54	29.91	..	fresh	SSW	rain
Thursday, 4	6 a. m.	52	.75	..	faint	..	cloudy and foggy—rainy
	10	56	.72	SSE—SW	..	SSW—W—SW	cloudy—fair at 1 p. m.
	2 p. m.	64	.72	SW	light	WSW	fair
	6	60	.65	S	..	SSW	..
	10	57	.67	..	..	WSW	..
Friday, 5	6 a. m.	53	.61	W—WNW	moderate	..	.. —light smoke
	10	56	.71	WNW—NW	..—fresh	NW	.. — ..
	2 p. m.	58	.75	NW-NW by W	fresh—mod'te	..	.. — ..
	6	50	.85	NNW	moderate	..	..
	10	47	.90	..	..		clear
Saturday, 6	6 a. m.	43	30.02	NNW—N	light		..
	10	50	.09	N—SW	..		..
	2 p. m.	60	.08	SSW	..		..
	6	55	.05	S by W	..	WSW	fair
	10	49	.10	..	..		..

NEW-YORK.

Date.	Hours.	Thermometer.	Barometer.	Winds.	Strength of Wind.	Clouds from what direction.	Weather and Remarks.
Sunday, April 7	6 a. m.	46	30.18	s by w—se	light	wsw	fair—light smoke
	10	56	.20	se	..	..	.. —smoky and hazy
	2 p. m.	56	.18	se—ese	mod'te—fresh	wsw / sse	cloudy
	6	50	.07	ese	fresh	sse	..
	10	50	29.98	..	strong	..	.. —rain
Monday, 8	6 a. m.	50	.70	..	light	..	cloudy and foggy
	10	54	.66	se	..		rainy
	2 p. m.	56	.62	variable	faint	ssw—wsw	fair
	6	59	.60		calm	wsw	..
	10	49	.65		..		..
Tuesday, 9	6 a. m.	52	.75	nnw	fresh	ssw / n	fair
	10	56	.81	..	..		clear
	2 p. m.	63	.85	..	..		..
	6	61	.97	..	moderate		..
	10	54	30.01	..	light		..
Wednesday, 10	6 a. m.	48	.08	..	faint		..
	10	53	.11	..	..		..
	2 p. m.	62	.08	wsw—nw	light		..
	6	62	.04	nnw	faint	nnw	fair
	10	54	.05				cloudy
Thursday, 11	6 a. m.	50	.03	ne	light–moder'e	nw	fair
	10	52	.05	ese	moderate	..	..
	2 p. m.	55	29.95	se	..	w & nnw / ssw. brisk	..
	6	52	.79	se by e	light	.. / ..	.. —(clouded horizon)
	10	51	.70	..			.. —cloudy
Friday, 12	6 a. m.	51	.50	sse—s	light	sw	cloudy
	10	58	.47	ssw—sw	faint	ssw	..
	2 p. m.	68	.42	sw & variable	light	sw	fair—changeable
	6	51	.45	nnw	fresh	ssw / nnw	..
	10	53	.56	..	..		cloudy
Saturday, 13	6 a. m.	42	.65	..	moderate	nw	fair
	10	47	.72	..	fresh	..	..
	2 p. m.	47	.72	..	..	..	..
	6	46	.72	..	..	..	..
	10	43	.83	..	..	..	..
Sunday, 14	6 a. m.	42	.94	wsw	moderate		clear
	10	54	30.01	w by s	..		..
	2 p. m.	57	29.89	..	..	w	fair
	6	53	.91	..	..	w by s	..
	10	52	.95	..	..	..	..
Monday, 15	6 a. m.	38	30.25	s	..		..
	10	42	.27	..	..		..
	2 p. m.	47	.28	sse	..	wsw	..
	6	39	.29	..	..	sw	..
	10	38	.30	..	..	..	..
Tuesday, 16	6 a. m.	38	.29	ne by e	fresh	sw by s / e by n	fair
	10	43	.33	..	..	sw	..
	2 p. m.	58	.27	ene—e	moderate	..	.. —cloudy
	6	48	.24	e—ene	..	..	cloudy
	10	46	.20	ene	..	..	..
Wednesday, 17	6 a. m.	42	.12	..	light	..	..
	10	44	.13	variable	faint	..	..
	2 p. m.	48	.08	..	..	ssw brisk	..
	6	47	.10		..	..	..
	10	46	.13		calm		..
Thursday, 18	6 a. m.	44	.16	wsw	faint	wsw	foggy—fair
	10	51	.21	ssw—s	..—light	..	fair
	2 p. m.	62	.20	s	moderate	wsw / nw	..
	6	56	.18	..	..	wnw	..
	10	53	.24	..	..	..	..
Friday, 19	6 a. m.	48	.36	ne—e—ene	light		clear
..	10	55	.40	sw	..	wsw	fair—thin & elevated cirri

NEW-YORK.

Date.	Hours.	Thermometer.	Barometer.	Winds.	Strength of Wind.	Clouds from what direction.	Weather and Remarks.
Friday, April 19	2 p. m.	63	30.38	SW—S	moderate	WSW	fair—thin & elevated *cirri*
	6	56	.29	S	..	..	.. — ..
	10	50	.30		calm		.. — ..
Saturday,	6 a. m.	50	.26	SW	light	WSW / W	.. — ..
	10	58	.28	..	moderate	.. / ..	.. — ..
	2 p. m.	68	.22	..	..	WSW	.. — ..
	6	64	.15	..	..	..	..
	10	58	.15				..
Sunday, 21	6 a. m.	52	.09	SW	light	..	.. —foggy—fair
	10	62	.09	S	..	..	fair—thin *cirri*, highly elevated
	2 p. m.	68	29.91	..	moderate	..	.. — ..
	6	62	.85	..	light	..	.. — ..
	10	59	.84	..	..		..
Monday, 22	6 a. m.	54	.89	NW	moderate		clear
	10	60	.94	NNW	..	WNW	fair
	2 p. m.	68	.94	N—NE—ENE	light	..	..
	6	61	.94	ESE	..		clear
	10	57	.96		..		fair
Tuesday, 23	6 a. m.	52	.87	E	moderate	SW / E	cloudy—rainy—at 8 a. m. barometer 29.90)
	10	54	.82	SE—S	..	SW	cloudy—fair
	2 p. m.	64	.70	SW—ENE	..	SW and WSW	fair—cloudy
	6	62	.60	ENE	..	WSW	cloudy
	10	57	.73	..	..—gale	..	cloud'd horizon-gale in night
Wednesday, 24	6 a. m.	43	.95	NE	fresh	NE—(scuds)	cloudy and rainy
	10	44	30.07	N by E		..	..
	2 p. m.	44	.10	..	moderate	WSW / NE	..
	6	45	.14	..	..	.. / ..	fair—upper haze from WSW
	10	44	.17		..		..
Thursday, 25	6 a. m.	43	.20	WSW	..	W by S	..
	10	48	.24	WSW—SW	light	W by S / SSW	.. — light *cirrus* clouds from WSW
	2 p. m.	58	.20	S	moderate	W by S—WSW	.. —cloudy
	6	52	.19	S—SW	..	WSW to NW	cloudy—fair
	10	48	.19	SW	..	WNW	fair
Friday, 26	6 a. m.	45	.18	WSW—NNE	light		clear
	10	52	.23	N	moderate		..
	2 p. m.	58	.23	..	..		..
	6	58	.23	N by E	light		fair-at 7 low bank of clouds at W
	10	50	.27				..
Saturday, 27	6 a. m.	43	.37	ENE	..	N by E	..
	10	50	.40	SSW	..—moderate	N by E / SSW	..
	2 p. m.	58	.37	S	moderate	NNW	.. —light haze from NNW
	6	53	.33	..	..	..	.. — ..
	10	48	.35	..	..	..	.. — ..
Sunday, 28	6 a. m.	48	.31	SW	..	..	.. — ..
	10	47	.30	..	..	..	.. — ..
	2 p. m.	68	.21	SW by W	..	..	.. — ..
	6	64	.18	..	..	..	.. — ..
	10	60	.18	..	light		..
Monday, 29	6 a. m.	56	.11	..	moderate		clear—light smoke
	10	65	.13		..		.. — ..
	2 p. m.	77	.07		..		.. — ..
	6	73	.01	..	..		..
	10	69	.04	..	..		..

Average temperature of the week ending April 1st, 43.77.—Do. of the week ending April 8th, 53.22.—Do. of the week ending April 13th, 51.51.—Do. of the week ending April 22d, 53.62.—Do. of the week ending April 29th, 54.

Maximum of the barometer in March, on the 14th, 30.52—Minimun on the 25th, 29.57.—Range 0.95 inch.

The winds for the month of March were Northeasterly, including North, during 29½ periods of observation; Southeasterly, including E, 21; Southwesterly, including S, 49½; and Northwesterly, including W, 47.

The observations of the highest atmospheric currents, as indicated by the clouds during March, are as follows:—from the Northeastern quarter, 4; from the Southeastern, 4; from the Southwestern, 53; and from the Northwestern, 25.

MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

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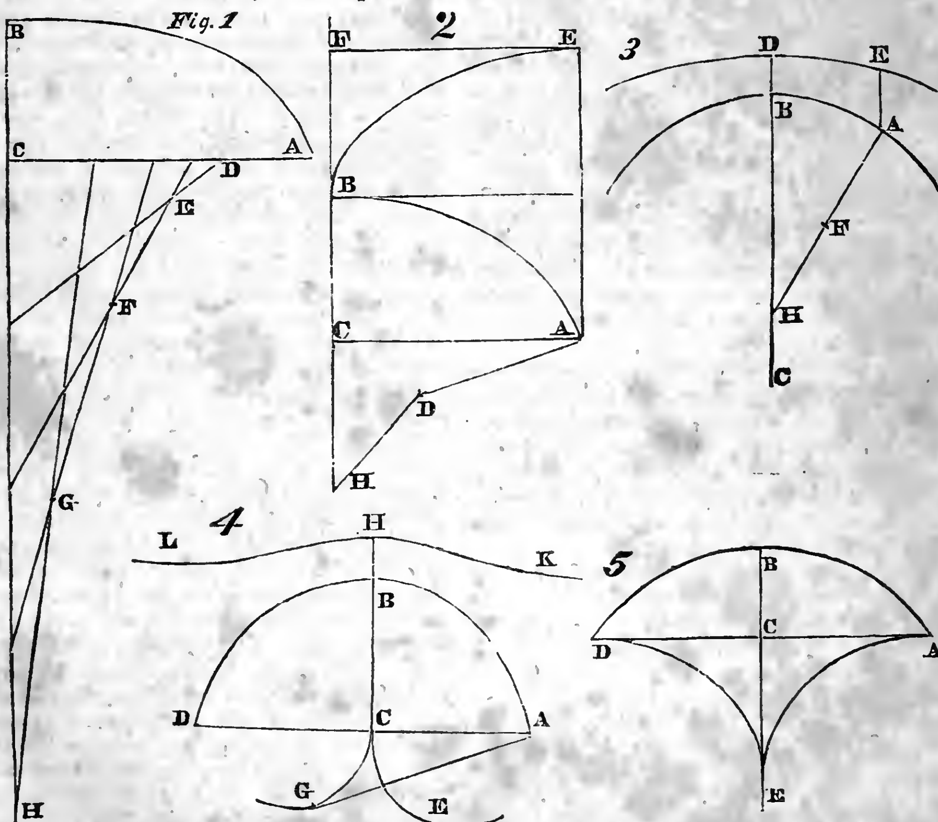
They helped every one his neighbor; and every one said to his brother, Be of good courage: so the carpenter encouraged the goldsmith, and he that smootheth with the hammer him that smote the anvil, saying, It is ready for the soldering; and he fastened it with nails that it should not be moved.—ISAIAH, chap. xii. ver. 6, 7.

On the Methods of describing various Curves for Arches. By J. THOMSON, Civil Engineer, Nashville, Tenn. [From the American Journal of Science.]



MR. EDITOR—The following observations on the methods of tracing various curves for arches are submitted for publication in the American Journal, with the hope that they may be found useful to mechanics, by saving the time and labor of tedious calculation.

The merely practical mechanic, unacquainted with algebraical calculations, is still

uninformed in regard to the method of finding the point D (fig. 1), or the distance C D, the determination of which is the only difficulty he will encounter. The distance C D, in that communication, is only expressed in indefinite parts, and not by means of a quantity derived from the ratio of A C to C B.

In order to find C D, *divide the difference of the rise and half span* of the arch by the following decimal numbers:

For five centers, divide by 0.794.
For seven centers, ‘ ‘ 0.771.
For nine centers, ‘ ‘ 0.758.
For eleven centers, ‘ ‘ 0.749.

The method of finding these divisors will be given hereafter. It may be observed that the last divisor is nearly $=0.75$, hence when eleven centers are used, multiply the above difference of rise and half span by 4, and divide by 3, the result will be the distance C D. Having found C D, make C H=3 C D. Take one from the number of centers to be used, and half the remainder will be the number of parts into which C H and C D are to be divided; C H into *equal* parts, and C D into *unequal* parts, increasing from D as 1, 2, 3, &c. Join these points of division, as in the figure, by straight lines, whose intersections will give the centers H, G, F, &c. Thus, when nine centers are used, as in the figure, C H is divided into four equal parts, and C D into the same number of unequal parts, increasing as 1, 2, 3, 4, from the point D.

To find the above divisors, put C D$=y$, A D$=x$ and the given quantities A C$=a$, and B C$=d$. Now when the number of centers is given, the broken line H D is equal to C D multiplied by a constant quantity; put this constant quantity $=c$, then H D$=cy$, and since the broken line A H must be equal to B H, we have

$$x+cy=d+3y, \text{ whence}$$
$$x=d+y(3-c), \text{ and since}$$
$$\text{A C}=\text{A D}+\text{C D},$$
$$a=y+d+y(3-c), \text{ hence}$$
$$y=\frac{a-d}{4-c}=\text{C D}.$$

In order to apply this general equation, c must be calculated for the required number of centers. For five centers, take C D= any assumed quantity, say three; then by trigonometry we find the sum of the lines that constitute H D=9.619, hence $c=\frac{\text{H D}}{\text{C D}}=3.206$. In the same way we find for seven centers $c=3.229$, and for nine centers $c=3.242$, and for eleven centers $c=3.251$. Hence we have for

$$\text{Five centers, C D}=\frac{a-d}{0.794}$$
$$\text{Seven centers, C D}=\frac{a-d}{0.771}$$
$$\text{Nine centers, C D}=\frac{a-d}{0.758}$$
$$\text{Eleven centers, C D}=\frac{a-d}{0.749}$$

Since it is thus almost as easy to trace an oval arch with nine or eleven centers as with three, the description of this arch by means of three centers ought always to be avoided, as it is not only disagreeable to the eye, but it is deficient in strength, in consequence of the sudden change of curvature resulting from this mode of description.

Perhaps no curve unites beauty and strength in a greater degree than the cycloid. The arch, equilibrated by a horizontal roadway, is remarkable for strength, but it is deficient in beauty. The elliptic arch is perhaps the most graceful, but when the rise is small, compared with the span, it will not admit of great pressure with safety at the crown. The cycloidal arch, with the same rise and span with an elliptic arch, is more curved at the crown than the latter, and hence it will sustain a greater weight at that point, such as a heavy load passing over it. We are not at liberty, however, to choose the ratio between the rise and span of this arch, these being always to each other as the diameter of a circle to the circumference.

The mechanical construction of the cycloid is very easy. The following method I have not seen noticed in any work on Mechanics. Having fixed upon the dimension of the half span A C, (fig. 2,) take the rise B C such that A C will be to B C as half the circumference of a circle to the diameter, the lines F H and A E being parallel to each other, and perpendicular to A C, and make C H=C B. Let the describing line taken equal to B H or twice B C, be extended from H to A, and brought to a proper tension by means of the point or pin D. The curve A B is then described with the centers D and H. This curve will be an approximation to the cycloid. Fix a number of centers (the more the better) along the curve A B, and with these centers describe the curve B E, which will be a cycloid as near as can be obtained by any mechanical

means. If, instead of a single point, D, three or four points be taken as centers between H and A, so arranged as to be nearly in a cycloidal curve, and keeping at the same time the line A D H at its proper tension, the resulting curve A B will itself be a very near approximation to the cycloid; but not much greater sensible accuracy can be attained in the second curve B E, than when a single point D is first assumed.

The above method of tracing this kind of arch is derived from the principle, that when any curve or broken line A D H is assumed between the parallel lines A E and F H, the successive developments or involutes A B, B E, &c. between the same parallels, constantly approach to, and finally terminate in a cycloid. These involutes converge so rapidly to the form of this curve, that when the above method is adopted, the second involute B E may always be assumed in practice as the required curve.

One advantage that might be mentioned, in tracing curves for arches with a variable radius, is that we may always obtain the height of the road-way above any point in the arch, such that it may be equilibrated by the superincumbent weight. Thus, let D E (fig. 3) represent a road-way passing over the arch A B, let B C=radius of curvature at the point A, D B=height of road-way at the crown, then we have $AE=\frac{DB \times BC}{AF \times (\cos AHB)^3}$.

An arch that will require a gentle elevation of road-way at the crown, in order to produce equilibration, may be described by the following method. Let A D, (fig. 4,) represent the span of the arch, B C the rise; describe an arc C G of a circle on D C as a diameter; extend the describing line from A to G, where it is a tangent to the circle; the line being fixed at G, describe the half arch A B with centers arranged along the curve C G, and in the same manner describe the half arch B D with centers on C E. If the span A D be=100, A G will be=70.7, and hence the rise B C will be 40. It will be found from the above equation that this arch will be nearly equilibrated by a road-way of the form of L H K, gradually rising at the crown of the arch, when H B is taken equal to about one-fourth of the rise.

A very graceful arch may be described (fig. 5) by centers arranged along circles tangent to the span and axis of the arch, at the points D, E, and A, E. This arch will also admit with safety a horizontal road-way. The span of this arch will be to the rise as $2r$ to $\frac{1}{4}c-r$, r being the radius of a circle, and c the circumference, or the ratio will be as 1 to 0.2854. The use, however, of arches of this description is limited to cases where we are at liberty to adopt the constant ratio that necessarily exists between their rise and span.

Proposals for constructing a Steam Camel.

By John L. Sullivan, Civil Engineer.

To the Editor of the Mechanics' Magazine.

New-York, April 24, 1833.

Sir,—It will be recollected that the name of *camel* is given to the hollow floats, used to buoy up ships of war to cross barred harbors, especially at Amsterdam.

Wherever the current of a river meets the tide, a shoal is of course formed by the deposition of sediment, and may at length obstruct navigation. All that *art* can do, then, is to contract the passage, and by a more rapid current compel the shoal to form further down stream. The effect of dredging is but partial and temporary. Vessels might be fitted out for foreign voyages, at Albany, and the largest class of coasters come to this port, but for this obstruction.

The *Overslough* is becoming a more sensible impediment to vessels since the increase of the population and trade at this city. Being the seat of government, and the meeting of the lakes and the ocean, it might become very commercial.

In case no permanent work should be devised to remedy the inconvenience of this shoal, it has occurred to me that a *steam camel* is capable of being made, at once to raise and bear vessels of any size over it.

Having acquired the right to the recent improvement made in steamboats by Mr. Blanchard, for the North River Companies, I have invented, by the combination of two of them, with machinery, the instrument to which I have given the name of the *steam camel*.

The *peculiarity* of his boat was essential to its construction. It required that their hulls should be exceedingly light, yet very *stiff*, because vessels sit in the water according to the weight on board, and the displacement that equals it. The greatest weight will be in the broadest part of the vessel, but when she is lifted out that burden is transferred to the buoyant vessels, (or camel,) and will come on them somewhat unequally. And if so, their vertical strength must be such that one end may be depressed without injury to the

other: she must be incapable of changing her vertical shape.

The requisite lightness and stiffness of this vessel is owing to her frame being composed of *arches.* These arches are vertical and opposite, and their ends are connected strongly: they are then braced apart by cross studs, and then tied together by screw bolts close to each stud. Thus combining the strength of the column with the longitudinal strength of the fibre of the wood of the curves.

Two such frames placed parallel and vertical, and resting the inverted arch on the floor timbers, the hull receives any desired model. The ends project far enough to bear up the impelling wheel, which is thus placed at the stern, and others may, for great speed, be placed also at the sides. The cylinders lay horizontal, in connection with the frames, and thus the most vigorous action of the engine can be well sustained. This kind of steamboat draws about *one foot,* all on board. So far as we have experience, her performance is extraordinary. One runs up the Connecticut, over Enfield falls, between Hartford and Springfield; another runs up the Kennebec, from Gardiner, over the rapids, to Waterville. Another has ascended the Alleghany as far as Hamilton, the key to a direct trade with the valley of the Mississippi, from New-York, without the intervention of aid by the laws of other states: probably of future consequence.

Two of these light and stiff steamboats being properly *connected,* yet apart sufficiently to come on both sides the vessel to be assisted, she is lifted as much out of the water as is requisite, by means of their steam power, and the application of the machinery, combined with them, to form the *camel;* and then applying the power to the wheels, she is carried quickly over the shoal. Thus any vessel might load at Albany, and be carried below the shoals, or be brought up, loaded; and sea vessels brought up more easily than to New-Orleans.

The Dutch camel is filled with water, and brought under the sides of the ship, when, on being *pumped out,* they buoy her up; but this is a slow process. The impatient trade of the Hudson requires the most active aid. In five minutes the vessel should be raised, and in ten more set down. The specification of this improvement is too long for insertion in this place. This notice serves merely to show that the nature of the shoal is such as not to permit of a radical remedy, but may be thus practically surmounted.

JOHN L. SULLIVAN, Civil Engineer.

[From the American Railroad Journal.]

IMPROVEMENTS IN PENNSYLVANIA.—Internal improvements in this state are progressing with extraordinary rapidity. It appears from the report of the Canal Commissioners, read in Senate Dec. 6, 1832, that, of the works constructed by the State, there are completed in canals now navigable, *miles* 479½

completed in canals now navigable, *miles*	479½
In hand and likely to be completed during the present year, - -	103½
Independently of these, there are others constructed at the expense of corporations, and now in actual use, -	280¼
Thus on the 1st January, 1834, the total of navigable canals will be -	863¼

In the construction and completion of railroads, great progress is making also. We learn that there are 415½ miles either completed, or progressing so fast that nearly all will be completed during the present year. Independent of this, other companies are forming.

In the 14th number of the 2d volume of this Journal, for March 5th, will be found an interesting letter from Mr. Edmund S. Coxe, of Philadelphia, giving a description of some of the improvements going on, but as we conceive a more detailed list would not be uninteresting to our readers, we shall lay before them a complete list of railroads and canals, finished and unfinished, the greater part of which we copy from the Philadelphia Commercial Herald.

CANALS CONSTRUCTED BY THE STATE.

1. Canal from Columbia, on the Susquehannah, to the mouth of the Juniata, and up the Juniata to Hollidaysburg, at the eastern base of the Alleghany mountain—distance 171 miles 246 perches.

2. Canal from Johnstown on the Conemaugh, at the western base of the Alleghany, down the Conemaugh, Kiskeminetas and Alleghany, to Pittsburg—distance 105 miles. [The above lines, connected by the "Portage Railroad," over the mountain, form the great east and west communication. It has a double connection with Philadelphia, one from Columbia, by way of the Pennsylvania Railroad, and the other from Middletown, nine miles below Harrisburgh, and eighteen miles above Columbia, by the Union Canal.]

3. Canal from the mouth of the Juniata up the Susquehannah to the forks at Northumberland, then up the north branch to a point 2 miles below Wilkesbarre. Distance 96 miles 295 perches. [It is contemplated to extend this at some future day to the north

line of the state, when a communication by canal and railroad will take place with the Erie Canal.]

4. Canal from Northumberland, at the forks of the Susquehannah, up the west branch to the Muncy dam—distance 26 miles 160 perches. [For extension see below.]

5. The French creek feeder, intended to supply with water the future communication between the Ohio and Lake Erie—length 19 miles.

6. A canal from Bristol to Easton, on the Delaware—length 59 miles 240 perches. [This is the channel by which the coal trade of the Lehigh reaches Philadelphia.]

CANALS CONSTRUCTED AT THE EXPENSE OF CORPORATIONS, AND NOW IN ACTUAL USE.

7. The Union Canal, from the Schuylkill opposite Reading, to the Susquehannah at Middletown—length 82 miles 88 perches. Branch Canal and feeder, belonging to the Union Canal Company, 22 miles in length, with a railroad of four miles to the Pine Grove coal mines.

8. The Schuylkill Navigation, from Port Carbon on the Schuylkill to Philadelphia—length 108 miles.

9. The Lehigh Canal, from Easton on the Delaware up the Lehigh to Mauch Chunk—distance 46 miles.

10. A part of the Hudson and Delaware Canal, from Honesdale on the Lackawaxen to the mouth of that stream—supposed 20 miles.

11. Conestoga Navigation, an improvement of Conestoga creek by locks and dams from its mouth up to the city of Lancaster—distance about 14 miles.

12. The Codorus Navigation, an improvement of Codorus creek from its mouth up to the borough of York—length about 10 miles.

Total of canal navigation now in use, 759¾ miles.

The canals authorized and now in progress at the expense of the State, and likely to be navigable by the end of this year, are

From Muncy dam on the West Branch up that river to the mouth of Bald Eagle creek. Distance 40 miles and 18 perches. [This is an extension of No. 4, and will complete the improvement contemplated in that quarter.]

From two miles below Wilkesbarre up the north branch of the Susquehannah to the mouth of the Lackawanna—distance 12 miles 316 perches. [This is an extension of No. 3, and will leave about 90 miles towards the north line of the State untouched.]

From the confluence of the Beaver with the Ohio, (20 miles below Pittsburg,) up the former river to Newcastle—distance 24 miles 240 perches. [This is the commencement of a communication between the Ohio and Lake Erie, which will pursue a northerly direction up the valley of the Chenango to the summit at Conneaut lake, thence to Lake Erie, at the town of Erie. At the Conneaut summit it will be supplied with water from French creek, by a feeder described above as No. 5. From Newcastle to Erie, by the route selected, will be about 78 miles.]

A canal and slackwater along French creek, from the commencement of the feeder to the junction of that creek with the Alleghany—distance 25 miles 224 perches. [This work does not form a part of any great communication.]

By this statement it appears that after the present year only 90 miles on the north branch of the Susquehannah river, and 78 miles between the Ohio and Lake Erie, will remain to complete the whole system of improvement adopted by the State of Pennsylvania, and upon which operations commenced in the summer of 1826, less than seven years ago. That system will embrace when completed:

1. A great line of communication from Philadelphia, passing by Lancaster, Columbia, Middletown, Harrisburgh, Lewistown, Huntingdon, Hollidaysburg, Johnstown, Blairsville, Pittsburg, Beaver, Newcastle, and Meadville, to the Borough of Erie, on Lake Erie. The whole distance 481 miles, of which 118 miles is by railroad, 20 miles by the Ohio river, and 343 miles by canal. Distance from Philadelphia to Pittsburg 358 miles. [This passes through the great iron region of the Juniata, the salt and bituminous coal of the Conemaugh, Kiskeminetas, and Alleghany, and a country abounding in agricultural product.]

2. A great line from Philadelphia to the junction of the Tioga with the north branch of the Susquehannah, on the boundary of New-York, where a communication is now forming with the Erie Canal, by way of Chenango Point. This line diverges from the former at the mouth of the Juniata, and passes Liverpool, Selin's Grove, Northumberland, Danville, Berwick, Wilkesbarre, Pittston, Towanda, and Athens. It passes through

the Wyoming coal region, and opens a rich agricultural country to market. Whole distance 324 miles, of which 81 miles are by railroad, and 234 by canal—common to the great western route, 81 miles of railroad and 43 of canal.

3. The West Branch Canal, from the mouth of Bald Eagle to the Forks at Northumberland, where it unites with the line last mentioned. It opens the richest land in the State, the valuable iron of Bald Eagle valley, and the inexhaustible beds of bituminous coal on the West Branch and its tributaries. These articles will have their choice of markets between Philadelphia and the interior of New-York, where both are needed.

4. The Improvement of French creek and the Delaware Canal, which at present are rather detached works than parts of any great system of communication.

This brief summary, including all the works undertaken or contemplated by the State, is sufficient to show that the Pennsylvanian system of improvement is simple in itself, and that almost every part is necessary to the perfection of the whole. By an examination of the map it will appear that every important section of the State, which it was practicable to reach, has been brought into communication with the city of Philadelphia. The counties on the southern border, whose waters run into the Potomac and Monongahela, are alone excluded—and that by the operation of paramount natural causes.

RAILROADS.

1. Pennsylvania Railroad, constructed at the expense of the State, from Broad street, Philadelphia, to the Susquehannah at Columbia, and there joining the Southeast termination of the State Canal,—distance 81½ miles —30 miles being in actual use, and the whole in a fair way to be finished this year.

2. Portage Railroad—constructed by the State—across the main Alleghany mountain by a series of inclined planes, connecting the Juniata at Hollidaysburg with the Conemaugh, at Johnstown—distance 36 69-100 miles, including a tunnel of 900 feet long, four large viaducts, and other works of great magnitude. This unites the Eastern Canal with the Western, and will complete the line of communication between Philadelphia and Pittsburg. A great part of this work is now completed, and will be in use next year.

3. The West Chester Railroad* is a branch from the Philadelphia Railroad to the flourishing village of West Chester. It unites with the Pennsylvania Railroad on the South Valley Hill, two miles west of Paoli. It is the property of a Company composed of enterprizing citizens of Philadelphia and West Chester. Length nine miles—cost about $100,000. Completed, and now in use.

4. The Philadelphia, Germantown, and Norristown Railroad. The line begins at the intersection of Spring Garden and Ninth streets, and terminates at Norristown. Six miles of this distance are completed, and now in use. Preparations are making to finish the remainder. Made at the expense of a company.

5. Little Schuylkill Railroad. From Port Clinton, at the mouth of Little Schuylkill, to the village of Tamaqua, on that stream —distance 21½ miles, with several branches to coal mines. This is the work of a company, and is designed, principally, to transport coal to the Schuylkill navigation. Finished and in use.

6. Mine Hill and Schuylkill Haven, at the mouth of the West Branch of Schuylkill, up that stream 10½ miles to Mine Hill Gap. Finished and in use. Trade, coal. Belongs to a company.

7. Mount Carbon Railroad. From Mount Carbon, one mile below Pottsville, up the valley of the Norwegian creek—main line and branches about seven miles. Finished and in use. Trade, coal. Belongs to a company.

8. Danville and Pottsville Railroad. From Pottsville to Sunbury, opposite the forks of the Susquehannah. Length 45 miles—eight miles nearly completed. It is designed to accommodate the great coal region on the Shamokin, Mahoney, &c. and to connect the Susquehannah with the Schuylkill canal. Belongs to a company.

9. Schuylkill Valley Railroad. From Port Carbon at the head of the Schuylkill navigation, up that river to the town of Tuscarora—distance 10 miles. Trade, coal. Belongs to a company. Finished and in use.

10. The Mauch Chunk Railroad. The first of any magnitude completed in the United States. From the head of the Lehigh Canal at Mauch Chunk, to the coal mine on the summit of Mauch Chunk mountain. Aggregate of main line and branches, 12¾ miles. Belongs to the Lehigh Coal and Navigation Company.

11. The Roan Run Railroad. From Mauch Chunk, up the Lehigh to a Coal

* See Railroad Journal, No. 5. Vol. 2.

Mine—length $5\frac{1}{4}$ miles. Finished and in use. Belongs to the above company.

12. Lyken's Valley Railroad. From Millersburgh to the Susquehannah, up Lyken's Valley, to a Coal Basin in the Broad Mountain. Distance $16\frac{1}{2}$ miles. Begun, and will be completed this year.

13. Carbondale Railroad. Belongs to the Hudson and Delaware Canal Company, and connects that work with the Coal Mines in the valley of the Lackawanna. Length of road $16\frac{1}{4}$ miles. Finished and in use.

14. The Philadelphia and Trenton Railroad. From Philadelphia to the Delaware Bridge, near Trenton. Distance $27\frac{1}{2}$ miles. The line is located, and contracts made for grading and bridges. To be finished this year. The rails will be laid next year. Belongs to a company, and is designed to accommodate transportation between Philadelphia and New-York.

The above list is believed to comprise all the important Railroads in Pennsylvania, actually finished, or upon which arrangements have been made for their early completion. Some smaller or branch lines have been probably overlooked. There are also several very important works which have been authorized by law, and which there is reason to hope will be soon commenced. Of this class are the Williamsport, and Elmira, and Phillipsburg, and Juniata Railroads. We have not named the York and Baltimore Railroad, as we believe that portion of it which lies in Pennsylvania has not been commenced.

Among other documents connected with these interesting subjects, we have been favored with a report of a survey made by Mr. R. Taylor,* Engineer, with a view of forming a railroad from the coal and iron mines near Blossburg, to the state line at Lawrenceville, a distance of twenty-six miles. Mr. T.'s report is rendered exceedingly interesting by the numerous tables and descriptions it contains of the various mineral sections of the mining districts surrounding Blossburg. Speaking of the mineral resources of the Tioga Valley, after giving a detailed account of those sections, showing the position and thickness of the respective beds of coal, iron, fine clay, sand stone, slate, shell, and other strata, he thus proceeds:

"In taking a general view of this district it will be seen that the valley of Blossburg forms a kind of central point or area, from whence diverge, irregularly, a number of smaller valleys or deep ravines. All these valleys, to the number of twelve, rise with a rapid inclination above the level of this area, until they intersect the mineral strata of the surrounding mountains, at elevations, between the lowest and the highest, of from 200 to more than 380 feet, the prevailing elevation of the summits or table lands being 500 or 600 feet above Blossburg bridge. Coal and iron ore of different qualities prevail extensively, and, when thus intersected by deep ravines, occur under the most favorable known circumstances for mining, and for transmission upon railroads.

"Almost every valley is capable of maintaining its separate branch railroad, and of conveying its contribution of these important products to the principal line.

"The series of mineral strata are estimated to be crossed by the Tioga river at from 5 to 8 miles east from Blossburg. The examination has been thus far pursued, and traces of minerals are discernible throughout that distance; but as the river passes through gravelly alluvial bottoms, where the banks are not washed or exposed, their examination was left in an incomplete state. The whole inclination is perfectly practical for railroad purposes, whenever it should be thought necessary to locate one down the valley.

"At the forks near Fishing Camp, about five miles up the Tioga, this river is joined by Fellow's creek, which traverses another section of this district from the northeast. The upper part of this ravine is crossed by three falls, in succession, descending about one hundred feet. Below them are numerous indications of the proximity of coal and iron, but the banks are too much obscured by alluvial deposites to exhibit the precise sites of the mineral beds on a single examination. Several small ravines descending into this branch, and into Morris' Run, contain traces of coal.

"On the east side of the Tioga, nearer Blossburg, are the four principal ravines of East Creek, Bear Creek, Coal Run, and Morriss' Run. There are two or three other ravines in the same direction, where the coal beds are approachable. On the west are the two ravines of Boon's Creek and Johnson's Creek.

* Report on the Surveys undertaken with a view to the establishment of a Railroad from the coal and iron mines near Blossburg, or Peters's Camp, to the State line at Lawrenceville, in the county of Tioga, and the state of Pennsylvania, and Mineralogical Report on the coal region in the environs of Blossburg. By Richard C. Taylor, Engineer. Philadelphia. Mifflin and Parry. 1833.

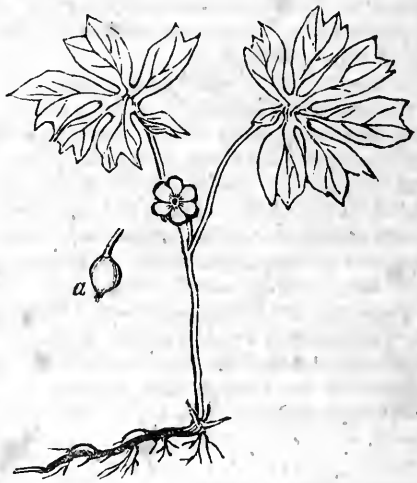
"Three miles below Blossburg there is a regular dip, at the rate of 260 feet to the mile southward, which increases until at 17 miles it is about 500 feet in a mile, and then decreases to 200 feet per mile, at the State line, or 26 miles.

"If we pursue this examination for the sake of a more extended geological result, our position will be yet further strengthened.

"At 33 miles below Blossburg, the southern dip is 168 feet in each mile; and at 38 miles, near the Painted Post, was found to be 130 feet. At 42 miles, at the Chimney Narrows, in the same parallel, near the entrance of the Chemung feeder, this dip is about 100 feet, making the aggregate southern depression of the strata about 1050 feet more to this point, to be added to 70 feet, the descent of the land from the state line Uniting, therefore, these sums with those before observed in the Pennsylvania division, the altitude of any land or mountains near the Chimney Narrows, capable of containing the veins of the Tioga coal field, must be more than 6000 feet, whereas they do not commonly exceed 600 feet; or by reversing the position, the stratum of rock on a level with the river of Chimney Narrows would be about 6275 feet below the summit of East Hill, if prolonged so far to the south. I may add that I have had an opportunity of extending the examination 60 miles further, or more than 100 miles from the coal beds, to the north and north-east; and a general observation may be made, that wherever a horizontal position [which often prevails] is not maintained throughout this parallel, there exists a depression pointing towards the Tioga coal district, or, generally, south. Consequently there is no probability that any portion of these mineral beds are prolonged in that direction, and, as has been before suggested, we must continue to regard the district which is the more immediate subject of our investigation, and from which I have somewhat wandered, as the real termination of the great Alleghany coal field."

Mr. Taylor's report is drawn up with great ability, and is of itself evidence of great industry and perseverance on his part. We sincerely hope that this most important plan will very soon be added to the list of works in active operation, feeling confident that it will materially benefit the commercial interest of Pennsylvania.

Co-operation of Schools.—The Convention of Teachers now in session at Andover have entered promptly and warmly into measures to co-operate with the School Agent Society. The plan of a general co-operation of schools throughout the Union, by collecting and exchanging specimens of Natural History, Journals of the Weather, &c. was fully developed and unanimously approved. It was particularly proposed that each school should note the number of rainy and clear days, and occasionally give them to the public, and have them brought together in some journal in such a way that they could be compared. By this means, the citizens of New-Orleans, St. Louis, Columbus (O.), Quebec, Boston, New-York, Charleston (S. C.), and Savannah, could compare the state of the weather, from month to month, and for the whole year.



Podophyllum Peltatum (*May Apple.*) By Q. Z. [From the New-York Farmer.]

Polyandria Monogynia, of Linnæus.

Ranunculaceæ, of Jussieu.

Calyx, three-leaved; corolla, about nine-petalled; stigma large, crenate, sessile; berry, one-celled, crowned with the stigma, large, many seeded; columella, one-sided.—*Eoton.*

Stem, one-flowered; leaves, peltate, palmate, lobate; lobes, cuneate, incised.—*Barton's Com. Flo. Phil.*

Podophyllum is derived from two Greek words πους, a foot, and φυλλον, a leaf, in allusion to the resemblance of the leaf to the web-foot of aquatic birds. This species, the May apple, is a common plant in many sections of our country, from the Canadas to Florida. It is found on the borders of rich shady woods, and by the sides of rivulets of water. The root is creeping, and grows from three to six feet in length. The whole plant is about a foot high. It consists of two leaves on a single stem, which, in the

junction formed by the footstalks of the leaves, supports a flower, and afterwards a fruit. The flower is white, the stamens yellow, from thirteen to twenty in number. The fruit (*a*) is lemon-colored, is about the size of a common garden plum, possessing when ripe an acidity and flavor by most persons highly esteemed. It is "exclusively a native of North America," blooming in the Middle States in May, and ripening its fruit in September.

Medicinal Properties.—The root of this plant is highly valued for its medicinal properties. "There is no indigenous plant whose virtues are better ascertained at present. Its proper place in the materia medica is among *cathartics*, and it may be ranked among the most safe and active of this class of medicines;"* the dose is a tea-spoon-full of the pulverized root, taken in sugar water or any other convenient form. Q. Z.

Newburgh, March, 1833.

Architecture.—Without entering deeply into the subject of Architecture, we propose to devote a portion of our succeeding pages to the explanation of the general and fundamental principles upon which this highly interesting and beautiful science depends.

The science of Architecture has at all times, and in all civilized countries, been considered not only a pleasing but a highly useful branch of knowledge.

The great utility of this science, and the elegant accomplishments connected with its study, have almost rendered a knowledge of its rules and principles necessary to complete a liberal education. But it is not our intention to bestow encomiums on the science, nor to give any thing like a detailed history of it, but to present our readers with a plain and condensed account of what may be termed its elementary principles.

Architecture is usually divided, with respect to its objects, into three branches, *civil*, military, and naval.

Civil Architecture, called also absolutely, and by way of eminence, *Architecture*, is the art of contriving and executing commodious buildings for the uses of civil life; as houses, temples, theatres, halls, bridges, colleges, porticoes, &c.

Architecture is scarcely inferior to any of the arts in point of antiquity. Nature and necessity taught the first inhabitants of the earth to build themselves huts, tents, and cottages; from which, in course of time, they gradually advanced to more regular and stately habitations, with variety of ornaments, proportions, &c. To what a pitch of magnificence the Tyrians and Egyptians carried *Architecture*, before it came to the Greeks, may be learned from Isaiah xxiii. 8. and from Vitruvius's account of the Egyptian Oeci; their pyramids, obelisks, &c.

Yet, in the common account, *Architecture* should be almost wholly Grecian original: three of the regular orders or manners of building are denominated from them, viz. *Corinthian*, *Ionic*, and *Doric:* and there is scarcely a single member, or moulding, but comes to us with a Greek name.

Be this as it may, it is certain the Romans, from whom we derive it, borrowed what they had entirely from the Greeks; nor do they seem, till then, to have had any other notion of the grandeur and beauty of buildings, beside what arises from their magnitude, strength, &c. Thus far they were unacquainted with any other beside the ***Tuscan.***

Under Augustus, *Architecture* arrived at its glory: Tiberius neglected it, as well as the other polite arts. Nero, amongst a heap of horrible vices, still retained an uncommon passion for building; but luxury and dissoluteness had a greater share in it than true magnificence. Apollodorus excelled in *Architecture*, under the emperor Trajan, by which he merited the favor of that prince; and it was he who raised the famous Trajan column, existing to this day.

After this, Architecture began to dwindle again; and though the care and magnificence of Alexander Severus supported it for some time, yet it fell with the western empire, and sunk into a corruption, from whence it was not recovered for the space of twelve centuries.

The ravages of the Visigoths, in the fifth century, destroyed all the most beautiful monuments of antiquity; and *Architecture* thenceforward became so coarse and artless, that their professed architects understood nothing at all of just designing, wherein its whole beauty consists: and hence a new manner of building took its rise, which is called the *Gothic*.

Charlemagne did his utmost to restore *Architecture;* and the French applied themselves to it with success, under the encouragement of H. Capet: his son Robert succeeded him in this design, till by degrees the modern *Architecture* was run into as great an excess of delicacy, as the Gothic had be-

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* Barton's Medical Botany, vol. 2, p. 14.

fore done into massiveness. To these may be added, the Arabesk and Morisk or Moorish *Architecture*, which were much of a piece with the Gothic, only brought in from the south by the Moors and Saracens, as the former was from the north by the Goths and Vandals.

The architects of the 13th, 14th, and 15th century, who had some knowledge of sculpture, seemed to make perfection consist altogether in the delicacy and multitude of ornaments, which they bestowed on their buildings with a world of care and solicitude, though frequently without judgment or taste.

In the two last centuries, the architects of Italy and France were wholly bent upon retrieving the primitive simplicity and beauty of ancient *Architecture*; in which they did not fail of success: insomuch, that our churches, palaces, &c. are now wholly built after the antique. *Civil Architecture* may be distinguished, with regard to the several periods or states of it, into the antique, ancient, gothic, modern, &c. Another division of *Civil Architecture* arises from the different proportions which the different kinds of buildings rendered necessary, that we might have some suitable for every purpose, according to the bulk, strength, delicacy, richness, or simplicity required.

Hence arose five orders, all invented by the ancients at different times, and on different occasions, viz. Tuscan, Doric, Ionic, Corinthian, and Composite. The Gothic Architecture may also be mentioned here, for it is perfectly distinct both from the Grecian and Roman style, although derived from the latter. [*To be continued.*]

History of Chemistry. [Continued from No. 4, page 209.]

Chemists had for many ages hinted at the importance of discovering a universal remedy for all diseases, and several of them had asserted that this remedy was to be found in the philosopher's stone. This notion gradually gained ground; and the word Chemistry, in consequence, at length acquired a more extensive signification, and implied not only the art of making *gold*, but also of preparing the universal Medicine. The first person who formally applied Chemistry to medicine was Basil Valentine, who was said to be born in 1394, at Erfurd, in Germany.

Just about the time that the first of these branches was sinking into discredit, the second, and with it the study of *Chemistry*, acquired an unparalleled degree of celebrity and attracted the attention of all Europe. This was owing to the appearance of Theophrastus Paracelsus, who was born in 1493, near Zurich, in Switzerland, and was in the 34th year of his age appointed to read lectures on Chemistry in the city of Basil. He was the first Professor of Chemistry in Europe.

Van Helmont, who was born in 1577, is considered as the last of the Alchymists. His death completed both the disgrace of the philosopher's stone and the universal medicine.

The foundation of the alchymical system being thus shaken, the facts which had been collected soon became a mere chaos, and Chemistry was left without any fixed principles, and destitute of any object. But fortunately, about this time arose a person completely acquainted with the whole of these facts, and rescued this branch of science from the oblivion into which it would soon have fallen. This person was the celebrated Beccher. He accomplished the arduous task in a work entitled *Physica Subterranea*, published at Frankfort in 1669. The publication of this book forms a very important era in the history of Chemistry, as it contains the rudiments of the science as taught at the present day. After the death of Beccher, Ernest Stahl, the editor of the Physica Subterranea, adopted and taught the theory of his master: but he simplified and improved it so much that he made it entirely his own, and accordingly it has been known ever since by the name of the *Stahlian Theory.*

Ever since the days of Stahl, Chemistry has been cultivated with ardor in Germany and the *North of Europe.* The most celebrated men which these countries have produced are Margraf, Bergman, *Sheel,* and Klaproth.

In France, soon after the establishment of the Academy of Sciences in 1666, Homberg, Geoffrey, and Lemery, acquired great celebrity by their chemical experiments and discoveries.

From that time chemistry became the fashionable study in France, and men of eminence appeared every where; discoveries multiplied; the spirit for chemical research pervaded the whole of that kingdom, and extended itself over the continent of Europe. After the death of Boyle, and some of the other *early* members of the Royal Society of London, little attention was paid to Chemis-

try in Britain, except by a few individuals, But when Dr. Cullen was appointed Professor of Chemistry in the University of Edinburgh, in 1756, he kindled a flame of enthusiasm among the students, which soon spread through the kingdom; and, after this, soon followed the important discoveries of Dr. *Black*, *Cavendash*, and *Priestly*, which, joined to the discoveries made in France, Germany, and Sweden, made the science of Chemistry burst forth at once with unexampled lustre. Hence the rapid progress it has made during the last thirty years, the universal attention which it has excited, and the unexpected light it has thrown on almost every useful art.

Having thus given a short but comprehensive view of the history of Chemistry down to our own times, we shall conclude this article by taking a retrospective view of some of the most distinguished THEORIES of the ANCIENTS, the various modifications which they have undergone at different times, and the steps by which chemists have been led to the opinions which they hold at present.

It seems to have been an opinion established among the most ancient philosophers, that there are only *four* simple bodies, out of which all others are formed, or to which all others may be reduced, viz. *fire*, *air*, *earth*, and *water*. To these they gave the name of *Elements*.

This opinion, variously MODIFIED, was maintained by *all* the ancient philosophers. It is, however, well known now that all these supposed *elements* are compounds, if we except fire.

Air is a compound of oxygen and nitrogen; water, of oxygen and hydrogen; and earth, of many different substances.

The doctrine of the four elements seems to have continued undisputed till the time of the Alchymists.

This class of men having made themselves much better acquainted with the analysis of bodies than the ancient philosophers were, soon perceived that the common doctrine was insufficient to explain all the appearances which were familiar to them. They therefore substituted a theory of their own in its place. According to them there are *three elements* of which all bodies are composed, namely, *salt*, *sulphur*, *and mercury*, which they distinguished by the appellation of the *tria prima*. These principles were adopted by succeeding writers, particularly by Paracelsus, who added two more to their number, namely, phlegm and *caput mortuum*.

It is not easy to say what the alchymists meant by *salt*, *sulphur*, and *mercury*; it is probable they had affixed *no precise* meaning to the words.

Every thing fixed in the fire (*i. e.* on which the fire had little or no effect) they called *salt*; every inflammable substance they called *sulphur*; and every substance which flies off without burning was *mercury*. Accordingly, they tell us that all bodies may be decomposed by fire, into these three principles; the salt remains behind fixed, the sulphur takes fire, the mercury flies off in the form of smoke. The phlegm and *caput mortuum* of Paracelsus were the *water* and *earth* of the ancient philosophers.

Mr. Boyle attacked this hypothesis in his *Sceptical Chemist*, and in several *other* of his publications, and proved that the Chemists comprehended under each of the terms salt, sulphur, mercury, phlegm, and earth, substances possessed of very *different properties*; and that these principles themselves are not *elements*, but *compounds*.

Mr. Boyle's refutation was so complete, that the hypothesis of the *tria prima* seems to have been almost immediately abandoned by *all* parties. About this time a very different hypothesis was proposed by Beccher, in his *Physica Subterranea*, which has been already mentioned.

To this hypothesis we are indebted for the present *state* of the *science*, because he first pointed out chemical ANALYSIS, as the true method of ascertaining the *elements* of bodies.

According to him all terrestrial bodies are composed of *water*, *air*, and three earths, viz. the fusible, the *inflammable* or sulphurous earth, and the *mercurial*. The different combinations of these, with a universal *acid* (which he believed to be composed of *fusible earth* and *water*), composed all the different substances which are to be met with in nature.

Stahl modified the theory of Beccher considerably. He seems to have admitted the universal acid as an element; the mercurial *earth* he at last discarded altogether, and to the *sulphurous earth* he sometimes gave the name of *ether*.

Earths he considered as of different kinds, but all of them as containing a certain element called *earth*. So that according to him there are *five elements*: air, water, phlogiston, earth, and the universal acid. He speaks too of *heat* and *light*; but it is not clear *what* his opinion was respecting them.

Stahl's theory was gradually modified by succeeding chemists.

The universal acid was tacitly discarded, and the different *known acids* were considered as distinct, undecomposed, or simple substances: the different earths were distinguished from each other, and all the metalic *calces* were considered as distinct substances.

For these important changes Chemistry was chiefly indebted to Bergman. While the French and German chemists were occupied with theories about the universal acid, that illustrious philosopher and immortal friend of Bergman's (Scheele of Sweden) loudly proclaimed the necessity of considering every undecomposed body as simple until it has been decomposed, and of distinguishing all those substances from each other which possess distinct properties.

Thus the elements of *Stahl* were, in fact, *banished* from the science of Chemistry, and in place of them were substituted a great number of bodies, which were considered as *simple*, because they had not been analyzed. These were phlogiston, acids, alkalies, earths, metals, metalic calces, water, and oxygen.

The rules established by Bergman and Scheele are still followed; but subsequent discoveries have shown that most of the bodies which they considered as *simple* are really compounds, while several of their *compounds* are now placed among *simple bodies*, because the doctrine of phlogiston (in which they believed) is now entirely abandoned.

The true etymology and origin of the word Chemistry is absolutely unknown. Both are enveloped in mystery, and lost in the darkness of ages past. Some historians of this science suppose its name derived from the word Kema, the pretended book of secrets, entrusted to women by the demons; others derive it from Cham, the son of Noah, from whom Egypt received the name of Chemia, or Chamia; some attribute it to Chemnis, king of the Egyptians; and others deduce it from a Greek word, which signifies *juice*, because they suppose it to have commenced with the art of preparing juices, or from another Greek word, to *melt*, because, according to them, it is the daughter of the art of smelting the metals.

Authors have been almost as much at variance with respect to the definition as to the origin and etymology of chemistry. Some have confined it only to the art of examining, extracting and purifying bodies, particularly metals; others have only considered it as that of preparing remedies. It is only since the middle of the eighteenth century that chemistry has been considered the science which ascertains the principles of which bodies are composed, and their different properties. But even this last definition is not accurate, because it neither comprises all the productions of nature, the principles of some of which are unknown, nor all the means of the science, which are not confined merely to the separation of the constituent parts of bodies.

The true definition which ought to be given in the present state of the sciences is much more general. The following may be adopted: Chemistry is a science by which we become acquainted with the intimate and reciprocal action of all the bodies in nature, upon each other. By the words intimate and reciprocal *action*, the science is distinguished from experimental philosophy, which only considers the exterior properties of bodies, possessing a bulk or mass capable of being measured; whereas Chemistry relates only to the interior properties, and its action is confined to particles whose bulk and mass cannot be subjected to admeasurement or calculation. The action of the same cause may, by a change of circumstances, pass from being an object of the one of these sciences to become that of the other. The action of heat, when it expands or contracts the dimensions of bodies, belongs to natural philosophy; when the same power burns and consumes bodies, its action belongs to chemistry. When it converts water into steam, it may belong to either science.

The object of Chemistry is to ascertain the ingredients of which bodies are composed; to examine the compounds formed by the combination of these ingredients; and to investigate the nature of the power which occasions these combinations.

The science, therefore, naturally divides itself into three parts: 1st, A description of the component parts of bodies, or of *simple substances*, as they are called. 2d, A description of the compound bodies formed by the union of simple substances. 3d, An account of the nature of the power which occasions these combinations. This power is now known in Chemistry by the name of *affinity*.

All the bodies in nature, considered in regard to the manner in which they are affected in chemical operations, present themselves to us either as simples or compounds; that is, such as have not yet been decomposed, and such as have been analysed, or separated into others less composed, or complex. Whenever, therefore, we use the phrase *simple bodies* in Chemistry, the term

is to be understood only of bodies not yet decomposed. We cannot assert that those bodies are really simple in themselves, or that they are not formed of other elements still more simple. We can only affirm that, in all the experiments which have been made, these bodies are found to act as if they were simple; that they cannot be decomposed by any process yet known; and that they can only be combined with other bodies, or made to form a component part of a compound body.

Natural bodies, considered under this point of view, present to chemists a very different aspect from what they did to those who held a different doctrine. Most of those bodies, which were formerly considered as simple and as the elements of all other bodies, are found to be more or less compounded; while many of those that were formerly considered as compounds are incapable of being decomposed, and can only be ranked among simple bodies.

The simple substances at present known amount to about *fifty*. These are divided by Dr. Thomson into two classes, which he names *confineable* and *unconfineable* bodies. By the first he means solids and liquids; and by the last airs and gases, heat, light, &c. The former may be exhibited in a separate state, but the latter cannot; and their existence is inferred merely from certain appearances which the first class of bodies, and their compounds, exhibit in particular cases, and under peculiar circumstances. It is therefore obvious, that an acquaintance with the properties of the first set of bodies is necessary in order to be able to investigate those of the second. We shall, therefore, consider these two classes separately.

But to form a classification of chemical facts, at once adapted to lead the student by *easy* and *certain* steps to a knowledge of this science, and at the same time conformable to the strict rules of philosophical arrangement, is attended with very great difficulty. For the science of Chemistry being chiefly confined to the investigation of the laws which bodies observe in combining together, or in separating from each other, it is impossible to enumerate the properties of any one substance which ought to be selected as the first object of investigation, without tracing the effects of many other bodies upon it, which must of necessity be previously known. The action of certain bodies is, however, much more general and extensive than that of others. It therefore appears to be the most natural order of considering this complex and extensive science, to begin by describing the properties and effects of one of the most important and singular substances in nature, which is *oxygen*.

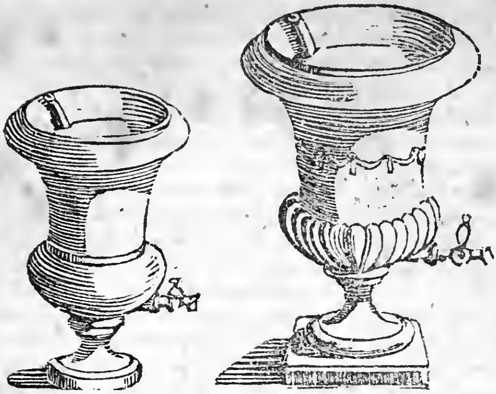
[*To be continued.*]

Clay for Sculptors.—Sculptors, who prepare their models in clay, have frequently occasion to leave their work for a long time unfinished, and in such cases often experience much difficulty from the drying and shrinking of the material. It is well to know that by the addition of ten to fifteen per cent. of muriate of lime, well worked or kneaded into the clay, it will be preserved for almost any length of time in a moist state, and fit for a renewal of the work without any preparation.—[Jour. des Connais. Nov. 1832.]

Pure Water.—Mr. Sullivan and Mr. Disbrow have obtained a joint patent for an improvement in the art of raising water from the interior of the earth, and have published a pamphlet, supplemental to Col. Clinton's Report, pointing out the advantages of forming a Rock Water Company,* in New-York city, for which purpose they have constructed machines and implements of which they are patentees, and several successful experiments have been made. Water is of such vast importance to the community, that we think the corporation of this city would render a very acceptable service to their constituents, by granting the petition of these gentlemen, or at least that part of it which prays that citizens might be *allowed* to supply themselves in the proposed way—which, it appears from the following extract from the pamphlet, cannot at present be done, without permission from the corporation:

"The command of an unlimited supply from the rock places New-York before Philadelphia in respect to this article, as we believe will be evident from the facts to be stated. The subject is therefore one of great public interest, though this *mode* is as yet a private concern; nor is it one that can be carried into effect without an act of incorporation which will enable those to take the water

* An Address to the Mayor, the Aldermen, and Inhabitants of the city of New-York, supplemental to Col. Clinton's Report, on Water, demonstrating, from the facts ascertained by the surveys, as well as others, the advantages of a Rock Water Company, with banking privileges, appropriating the surplus to public baths, and cleansing streets; also, a proposition to the Manhattan Company to fill their Aqueduct with Rock Water. By John L. Sullivan, Civil Engineer, and Co-Patentee with Levi Disbrow. New-York, Clayton and Van Norden.



who please to do it, and that those who yet have good wells be *exempt* from a *water tax.* This is indeed the case with several quarters where Mr. Disbrow has made borings for the corporation. But it is thought best now, for the public accommodation, to put the privilege of our patents, for this branch of usefulness, into the hands of a company, who may have a motive to give the utmost extension to the supply permanently. It is on this principle that London is supplied by five or six corporate associations. And it is thought to be more conducive to economy in practice, when personal attention is given to a concern in which we are interested."

Abernethy has well remarked that "Water is of such importance, not only as regards our drink, but also in preparing our food, that it may justly be said to be the vehicle of all our nourishment; so that whenever it possesses bad qualities, no wonder that on its passage through the body various diseases are engendered." How important, therefore, it is to obtain it pure, and until measures are adopted to afford a copious supply to the inhabitants of this city, we recommend the use of Mr. Parke's Filters, (see engravings,) by means of which rain water is rendered quite pure. They are for sale at No. 7 Wall street.

"The Patent Filter completely and effectually frees rain water collected from all deleterious earthy substances, and from all other impurities; thus rendering it pure and brilliant, and fit for drink and domestic purposes.

"Spring water has hitherto been used and preferred, but numerous medical authorities pronounce it injurious to health, as it usually holds in solution various earthy and metalic substances.

"The Patent Filter is highly requisite in every private family, hotel, and boarding house; as all kinds of food prepared in filtered rain water *is far more nutricious* than when prepared in spring water.

"The arrangement of the filtering part of this machine is such that they cannot get out of order for several years, if the instructions furnished by the patentee are attended to.

"The price of the Patent Filters are from eight to twenty dollars, and they will yield from *twelve to forty gallons of pure water* per day. The rapidity of the process being *six times greater* than that of the common filtering stone."

On the Atmosphere.—The atmosphere in which we live and breathe, its weight and pressure, and power, must excite in every reflecting mind a wish to be made acquainted with the causes of the phenomena of this ever agitated fluid. But little is known on the subject at present; all that is within our power is to collect and condense the few facts that are generally received as established, and lay them before our readers.—The subject is interesting to all, but to the lover of science especially so. It is useful to know that the constituents forming it are nitrogen and oxygen, with a small portion of carbonic acid gas, and many other curious facts, which will be found in this and the following pages:

Various conjectures have been formed with respect to the height of the atmosphere; and as we know to a certainty the relative weight of a column of the atmosphere by the height to which its pressure will raise water or mercury in an empty tube, so different calculations have been founded on these data, to ascertain its extent as well as its density at different heights. If the air of our atmosphere were indeed every where of a uniform density, the problem would be very easily solved. We should in that case have

notning more to do than to find out the proportions between the height of a short pillar of air and small pillar of water of equal weight; and having compared the proportion which the height these bear to each other in the small, the same proportions would be certain to hold good in the great, between a pillar of water thirty-two feet high and a pillar of air that reaches to the top of the atmosphere, the height of which we wish to know. Thus, for instance, we find a certain weight of water reaches one inch, and a similar weight of air reaches seventy-two feet high: this, then, is the proportion two such pillars bear to each other on the small scale. Now, if one inch of water is equal to seventy-two feet of air, to how much air will thirty-two feet of water be equal; by the common rule of proportion, we readily find that thirty-two feet, or 384 inches, of water, will be equal to 331.776 inches, which makes something more than five miles, which would be the height of the atmosphere, was its density every where the same as at the earth, where seventy-two feet of air were equal to one inch of water. But this is not really the case; for the air's density is not every where the same, but decreases as the pressure upon it decreases; so that the air becomes lighter and lighter the higher we ascend; and at the upper part of the atmosphere, where the pressure is scarcely any thing at all, the air, dilating in proportion, must be expanded to a very great extent; and therefore the height of the atmosphere must be much greater than has appeared by the last calculation, in which its density was supposed to be every where as great as at the surface of the earth. In order, therefore, to determine the height of the atmosphere more exactly, geometricians have endeavored to determine the density of the air at different distances from the earth.

The following sketch will give an idea of the method which some have taken to determine this density, which is preparatory to finding out the weight of the atmosphere more exactly. If we suppose a pillar of air to reach from the top of the atmosphere down to the earth's surface, and imagine it marked like a standard by inches from the top to the bottom, and still further suppose that each inch of air, if not at all compressed, will weigh one grain, the topmost inch then weighs one grain, as it suffers no compression whatever; the second inch is pressed by the topmost with a weight of one grain, and this, added to its own natural weight or density of one grain, now makes its density, which is ever equal to the pressure, two grains. The third inch, by the weight of the two inches above it, whose weight united make three grains, and these added to its natural weight give it a density of four grains. The fourth inch is pressed by the united weight of the three above it, which together make seven grains, and this added to its natural weight gives it a density of eight grains. The fifth inch being pressed by all the former fifteen, and its own weight added, gives it a density of sixteen grains, and so on, descending downwards to the bottom. The first inch has a density of one, the second inch has a density of two, the third inch a density of four, the fourth of eight, the fifth of sixteen, and so on. Thus the inches of air increase in density as they descend from the top, at the rate of 1, 2, 4, 8, 16, 32, 64, &c. Or, if we reverse this, and begin at the bottom, we may say, that the density of each of these inches grows less upwards. If, instead of inches, we suppose the parts into which this pillar of air is divided to be extremely small, and like those of air, the rule will hold equally good in both, so that we may generally assert that the density of the air from the surface of the earth decreases in a geometrical proportion.

This being understood, should we now desire to know the density of the air at any certain height, we have only first to find out how much the density of the air is diminished to a certain standard height, and thence proceed to tell how much it will be diminished at the greatest height that can be imagined. At small heights the diminution of its density is by fractional or broken numbers. We will suppose at once that at the height of five miles the air is twice less dense that at the surface of the earth: at two leagues high it must be four times thinner and lighter, and at three leagues eight times thinner and less dense, and so on. In short, whatever decrease it received in the first step, it will continue to have in the same proportion in the second, third, and so on, and this, as was observed, is called geometrical progression.

In proof of the great diminution in the elasticity of the air as we ascend from the earth's surface, it may be enough to state that if the common balloon was filled on ascending from the earth, the gas would burst its "silken envelope" long ere it had attained the ordinary elevation of those flying vehicles. One of the modes of ascertaining by direct experiment the diminished density,

consists in filling a flask with air at a given altitude, and then closing the aperture till the experimentor arrives at the earth's surface. The aperture is afterwards opened under water, and the difference between the air above and below is indicated by the quantity of water which enters.

Dr. Cotes has also shown that if altitudes in the air be taken in arithmetical proportion, the rarity of the air will be in geometrical proportion. For instance,

At the altitude of … Miles above the surface of the earth, the air is	… times thinner and lighter than at the earth's surface.
7	4
14	16
21	64
28	256
35	1024
42	4096
49	16384
56	65536
63	262144
70	1048576
77	4194304
84	16777216
91	67108864
98	268435456
105	1073741824
112	4294967296
119	17179869184
126	68719476736
133	274877906944
140	1099511627776

And hence it is easy to prove by calculation, that a cubic inch of such air as we breathe would be so much rarified at the altitude of 500 miles, that it would fill a sphere equal in diameter to the orbit of Saturn.

Upon the same principle it was attempted to calculate the height of the atmosphere, by carrying a barometer to the top of a high mountain, and the density of the air at two or three different stations was easily ascertained. But so feeble are human efforts in endeavoring to comprehend and measure the works of the Creator, that this theory was soon demolished. It was found that the barometrical observations by no means corresponded with the density, which, by other experiments, the air ought to have had; and it was therefore suspected that the upper parts of the atmosphere were not subject to the same laws or the same proportions as those which were nearer the surface of the earth. Another still more ingenious method was therefore devised. Astronomers know to the greatest exactness the part of the heavens in which the sun is at any one moment of time: they know, for instance, the moment at which it will set, and also the precise time at which it will rise. They soon, however, found that the light of the sun was visible before its body, and that the sun itself appeared some minutes sooner above the horizon than it ought to have done for their calculations. Twilight is seen long before the sun appears, and that at a time when it is several degrees lower than the horizon. There is then, in this case, something which deceives our sight; for we cannot suppose the sun to be so irregular in its motions as to vary every morning; for this would disturb the regularity of nature. Deception actually exists in the atmosphere; by looking through this dense transparent substance, every celestial object that lies beyond it is seemingly raised up in a similar way to the appearance of a piece of money in a basin filled with water. Hence it is plain, that if the atmosphere was away, the sun's light would not be brought to view so long in the morning before the sun itself actually appears. The sun itself, without the atmosphere, would appear one entire blaze of light the instant it rose, and leave us in total darkness the moment of its setting. The length of the twilight, therefore, is in proportion to the height of the atmosphere: or let us invert this, and say that the height of the atmosphere is in proportion to the length of the twilight: it is generally found, by this means, to be about forty-five miles high, so that it was hence concluded either that that was the actual limit of the atmosphere, or that it must be of an extreme rarity at that height.

Dr. Arnott, in his *Treatise on Physics*, gives a very beautiful and familiar view of the effects of atmospheric pressure in changing the temperature at various altitudes. The following is his explanation of the phenomenon: If a gallon of air at the surface of the earth contain a certain quantity of heat, this must be diffused equally through the space of the gallon; but if the air be then compressed into one tenth of the bulk, there will be ten times as much heat in that tenth as there was before; and the increase will affect the thermometer. In like manner, if by taking off pressure the gallon be made to dilate to ten gallons, the heat will be in the same proportion diffused, and any one part will be proportionably colder than before. It is known that air may be so much compressed under the piston of a close syringe, that the heat in it, similarly concentrated, becomes intense enough to inflame tinder attached to the bottom of the piston. This contrivance is in common use as a means of obtaining an instantaneous light, and is called the match syringe.

Now, for the reason here explained, the air near the surface of the earth, forming the bottom of the atmosphere, because con-

densed by the weight of the air above it, is much warmer than if it were suddenly carried higher up, where, from the pressure being less, it would be more expanded or thin. In many cases the height of mountains may be estimated by the difference of temperature observed at the bottom and at the top. While a thermometer stands at 60 degrees at the bottom of St. Paul's Cathedral, in London, another marks only 58 degrees at the top of the dome; and in the lofty ascent of a balloon, the thermometer soon falls to the freezing point, and below it, so that to the aeronaut the cold becomes almost insupportable.

In every part of the earth there is a certain elevation in the atmosphere, different according to the proximity to the equator, at which the thermometer never rises above the freezing point,—and this limit is called the level of perpetual congelation. In Norway, it is at five thousand feet above the level of the sea; in Switzerland, at six thousand five hundred; in Spain and Italy, at seven thousand; farther south, at Teneriffe, at nine thousand; directly under the sun, as in Central Africa, and among the Andes, in America, it is about fourteen thousand.

It appears, therefore, that the same low temperature may be met with at the equator as at the poles, by rising to find it; and we see why the snow-capt mountains are not the tenants only of high northern and southern latitudes. It is this truth which renders many parts of the tropical regions of the earth not only tolerable abodes, but as suitable as any on earth, although the ancient philosophers of Europe thought them, by reason of the great heat, uninhabitable by man, and an everlasting barrier between the northern and southern hemispheres. Much of the central land of America near the tropics is so raised, that as to agreeable temperature it rivals an European climate, while the lightness and purity of air, and the brightness of the sun, add delightfully to its charms.

The vast expanse of table-land forming the empire of Mexico is of this kind, enjoying the immediate proximity of the sun, and yet, by its elevation of seven thousand feet above the level of the ocean, possessing the most healthful freshness. The land in many parts has the fertility of a cultivated garden, and can produce naturally most of the treasures of vegetation found scattered over the diversified face of the earth. Mexico, well governed, might become a realization of Paradise. The plains of Colombia, in South America, and indeed all along the ridge of the Andes, are similarly circumstanced. What a singular contrast it is, after sailing one thousand miles up the level river Magdalena, in a heat scarcely equalled on the plains of India, all at once to climb from the low region to the table-land above, where Santa Fe de Bogota, the capital of the republic, is seen smiling over interminable plains, that bear the livery of the fairest fields of Europe.

Persons, not reflecting on the law which we are now illustrating, have expressed surprise that wind or air blowing down upon them from a snow-clad mountain should still be warm and temperate. The truth is, that there is just as much heat combined with an ounce of air on the mountain top as in the valley; but above, the heat is diffused through a space perhaps twice as great as when below, and therefore is less sensible. It may be the same air which sweeps over a warm plain at the side of a mountain, which then rises and freezes water on the summit, and which in an hour after, or less, is again found among the flowers of another valley, as a gentle and warm breeze.

As the temperature in different parts of the atmosphere depends thus upon the rarity of the air, and therefore upon the height, the vegetable productions of each distinct region or elevation have a distinct character; while many other peculiarities of places and climate depend on the rarity of the air.

The animal body is made up of solids and fluids, and the atmospheric pressure affects it accordingly. One has difficulty at first in believing that a man's body should be bearing a pressure of fifteen pounds on every square inch of its surface, while he remains altogether insensible to the influence; but such is the fact. Reflection discovers that his not feeling the fluid pressure is owing to its being perfectly uniform all around. If a pressure of the same kind be even many times greater, such, for instance, as fishes bear in deep water, or as a man supports in the diving bell, it must equally pass unnoticed. Fishes are at their ease in a depth of water where the pressure around will instantly break or burst inwards almost the strongest empty vessel that can be sent down; and men walk on earth without discovering a heavy atmosphere about them, which, however, will instantly crush together the sides of a thick iron boiler, left for a moment without the counteracting internal support of steam or air.

The fluid pressure on animal bodies, thus unperceived under ordinary circumstances, may be rendered instantly sensible by a lit

the artificial arrangement. In water, for instance, an open tube partially immersed becomes full to the level of the water around it, and the water contained in it is supported by what is immediately below its mouth: now, a flat fish resting closely against the mouth of the tube would evidently be bearing on its back the whole of this weight—perhaps 100 pounds; but the fish would not thereby be pushed away, nor would it even feel its burden, because the upward pressure of the water immediately under it would just counterbalance, while the lateral pressure around would prevent any crushing effect of the mere upward and downward forces. But if, while the fish continued in the supposed situation, the 100 pounds of water were lifted from off its back by a piston in the tube, the opposite upward pressure of 100 pounds would at once crush its body into the tube and destroy it. At a less depth, or with a smaller tube, the effect might not be fatal, but there would be a bulging or swelling of the substance of the fish into the mouth of the tube. In air, and in the human body, a perfectly analogous case is exhibited. A man without pain or peculiar sensation lays his hand closely on the mouth of a vessel containing air, but the instant that the air is withdrawn from within the vessel, the then unresisted pressure of the air on the outside fixes the hand upon the vessel's mouth, causes the flesh to swell or bulge into it, and makes the blood ooze from any crack or puncture in the skin.

These last few lines closely describe the surgical operation of cupping; the essential circumstances of which are the application of a cup or glass, with a smooth blunt lip, to the skin of any part, and the extraction by a syringe or other means of a portion of the air from within the cup. It may facilitate to some minds the exact comprehension of this phenomenon, to consider the similar case of a small bladder or bag of India rubber, full of any fluid, and pressed between the hands on every part of its surface except one, at which part it swells, and even bursts, if the pressure be strong enough. So in cupping medicinally, the whole body, except the surface under the cup, is squeezed with a force of fifteen pounds on the square inch, while in that one situation the pressure is diminished according to the degree of exhaustion in the cup, and the blood consequently accumulates there. The mere application of a cup with exhaustion constitutes the operation called dry cupping; to obtain blood, the cup is removed, and the affected part is cut into by the simultaneous stroke of a number of lancet points. The cup is afterwards applied as before, so that the blood may rush forth under the diminished pressure. The partial vacuum in the cup may be produced either by the action of a syringe, or by burning a little spirit in the cup, and applying it while the momentary dilatation effected by the heat has driven out the greater part of the air. The human mouth applied upon a part becomes a small cupping machine, and formerly, in cases of poisoned wounds, was used as such. It may be proper to add, that the late discoveries of Dr. Barry have shown that the timely application of a cupping-glass prevents the spread of contagion, either in cases of poison or hydrophobia.

If a flat piece of moist leather be put in close contact with a heavy body, as a stone, it will be found to adhere to it with considerable force; and if a cord of sufficient length be attached to the centre of the leather, the stone may be raised by the cord. This effect arises from the exclusion of the air between the leather and the stone. The weight of the atmosphere presses their surfaces together with a force amounting to 15 pounds on every square inch of those surfaces in contact. If the weight of the stone be less than the number of pounds which would be expressed by multiplying the number of square inches in the surfaces of contact by 15, then the stone may be raised by the leather; but if the stone exceed this weight, it will not suffer itself to be elevated by these means.

The power of flies and other insects to walk on ceilings and surfaces presented downwards, or upon smooth panes of glass in an upright position, is said to depend on the formation of their feet. This is such, that they act in the manner above described, respecting the leather attached to a stone; the feet, in fact, act as suckers, excluding the air between them and the surface with which they are in contact, and the atmospheric pressure keeps the animal in its position. In the same manner the hydrostatic pressure attaches fishes to rocks; and that "giant of the deep," the walrus, supports itself by a sort of air-pump apparatus in its feet.

Sewing on Glazed Calico.—By passing a cake of white soap a few times over a piece of glazed calico, or any other stiffened

material, the needle will penetrate with equal facility as it will through any kind of work. The patronesses of the School of Industry pronounce this to be a fact worth knowing, the destruction of needles in the ordinary way occasioning both loss of time and expense.—[Taunton Courier.]

On Comets.—It is a generally received notion among a great number of persons, that the near approach of a comet would break our planet in pieces, or at least produce a great accession of heat, sufficient perhaps to destroy animal and vegetable life, if not to burn the world altogether. The argument seems to have originated in a notion, that because heat produces expansion, therefore very highly expanded bodies must needs be very hot. It would be as good an argument to say, that because expansion by any other means except heat produces cold, that therefore all comets must be very cold; and neither argument would, in the least degree, afford matter even for a rational conjecture. We can form so little idea of what the state of a planet of vapor, it may be consisting only of one sort of matter, would be, that we might with as much reason speculate upon the possible organization of the possible animalculæ which swim in that vapor, as try in the present state of our knowledge to ascertain whether any and what degree of danger awaits us from such a source. A comet *may* certainly strike the earth in the next century; not one of these which are known, unless the laws of nature be singularly altered, but some one or other yet to come. It has been shown, but by considerations of so high a nature that the result cannot be expected to bring much conviction to any but a mathematician, that if a comet were launched at hazard into our system, for one orbit in which it could strike the earth there are 281 millions in which no such thing could take place as the laws of nature stand at present. The *advocates* of cometary interference (we have met with some whose manner of expressing their opinion on the subject almost entitles them to that name) usually suppose a special interposition of the Divine power, which resting on their own interpretations of certain scriptural prophecies,) they suppose will bring a comet on the earth. They are usually people of some religious feeling, and would act more consistently with the idea they ought to have of their own ignorance and the Divine power, if they ceased to prescribe to the Creator in what way it should please him to alter the course of events which it has hitherto been his will to arrange. It is impossible to produce any other argument on the subject, consistently with the design of this paper; the province of natural philosophy is to collect and compare facts, and to say what *will* be, if things continue as they *have* been; it never presumes even to conjecture what shall be, when the power which has hitherto disposed events in one manner shall judge it right to ordain a different arrangement.

As to the multitude of idle theories with which, for want of better information, this part of astronomy has been loaded, such as that the planetary system was formed by matter struck off from the sun by one comet; that another caused the deluge; that the four small planets were formerly one, which was broken in pieces by a third; that the moon was originally a comet, and the like: we would willingly amuse our readers by an account of them, if our limits permitted. They will however find them all handsomely exposed by M. Arago, in the *Annuaire* of the French Board of Longitude, for 1832. If any or all them should be hereafter proved to be true, it will be no excuse for those who first made them; for a result produced on insufficient evidence is bad, whether true or false. As the science of astronomy approaches towards perfection, we shall doubtless add some important and interesting facts to our knowledge of comets.

Hydro-Oxygen Microscope.—A considerable number of scientific persons attended to witness the first public display of the powers of this extraordinary optical instrument, which may be considered an improvement on the solar microscope. The great defect of the latter is that its effectiveness depends wholly upon the unclouded presence of the sun. Its operations, the result of refraction, are suspended whenever it is deprived of the full potency of the solar beams. In our climate, therefore, but especially in winter, it can be resorted to but seldom, and never with perfect satisfaction. To obviate this inconvenience, the aid of oxygen and hydrogen gas has been resorted to, and their united stream being directed against a piece of lime, produces a light of such vivid force as effectually answers all the purposes of strong solar illumination. We need not refer to the wonderful magnifying power of the solar microscope. Most of our readers must ere this be familiar with it. Suffice it to say

that it can in truth represent objects five hundred thousand times larger in size than they really are. Thus the pores of the slenderest twig, and the fibres of the most delicate leaf, expand into coarse net work. The external integuments of a fly's eyes, filled with thousands of lenses, appear in the dimensions of a lady's veil; that gentleman 'yclept the flea swells into six feet; worms seem like boa constrictors; while the population of a drop of goodly ditch water presents such shapes as Teniers should have seen before he pencilled the grotesque monsters who troubled the solitude of Saint Anthony. The hydro-oxygen microscope, we need scarcely add, promises to do much more for mankind than to gratify its curiosity. It will prove an important assistant in the investigation of physical science.—[Bell's Weekly Messenger.]

Improved Rotary Steam Engine. By Philo. To the Editor of the American Mechanics' Magazine.

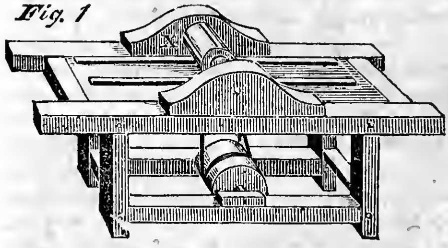
Lancaster, Pa. May 14, 1833.

Sir,—The "Improved Rotary Steam Engine," of which drawings and a description are given in the third number of the American Mechanics' Magazine, is not the invention of "Mr. Mollery, of Oswego," to whom it is credited in that Journal, but of Phineas Davis, of York, in this state. An engine precisely similar in principle, and differing very little in construction, was made by Mr. Davis, and used as the moving power of the Steam Clover Mill, which was burnt in the borough of York thirteen or fourteen years ago. The inventor, in connection with other gentlemen, was subsequently engaged in constructing an engine on the same principle and plan, at the foundry of Rush and Muhlenburg, in Philadelphia. That engine was intended to be applied to propelling a boat in the Delaware; the enterprise however failed—from some cause which is not distinctly remembered. There are many persons at York who would, from the drawings of Mr. Mollery's engine, at once recognise the identity of the machines. Two of Mr. M.'s engines, "of such dimensions that a man might easily carry one in each hand," are stated to propel a small vessel "of the size of a common canal boat," at the rate of "ten miles an hour," one engine being applied to each wheel. We will not question the correctness of this statement, but do not perceive, from the drawings or description, any such variation, in the construction adopted by the New-Yorker, as seems sufficient to account for a more successful application, by him, of the principle to steamboat navigation, than was accomplished by the original inventor. I am, sir, yours, &c.

Philo.

Description of Tichenor's Patent Machinery for making Window Sash, Pannel Doors, Window Blinds, and Pannel Work generally. Communicated by the Proprietors, for the American Mechanics' Magazine.

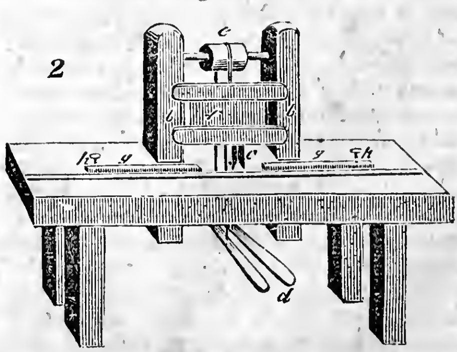
Fig. 1



For making window sash, &c. the plank is sawed up into proper lengths and widths by the use of circular saws, which are set on proper frames, for that purpose, the operation and construction of which are too generally known to need description.

The planing is done on a wooden frame, fig. 1, made of timbers four by five inches square, six feet long, two feet wide, and three feet high; on the top of this frame, which is a smooth surface, made so by plank laid level with the top of the plates, stands a circular cylinder, X, with cast steel knives or cutters, under which the stuff is passed to be planed while the cutters are in rapid motion. This cylinder may be raised or lowered at pleasure, to cut the thickness of the stuff to be planed. The small morticing is done in a small frame, fig. 2, two and a half feet

2



high, and of sufficient strength to support two upright standards or posts, *b*, in which

grooves are made for a slide to move; in the slide are two chisels, *c*, set for making the small mortice after boring. This is done by two treadles or levers, *d*, which are moved by the foot, one to press it down, and the other to raise it up, by means of a cord, *e*, passing over a pulley, which is attached to the slide, *f*, containing the chisels. The stuff to be morticed is kept in its place by the gages, *g g*, which are fastened by screws, *h h*.

3

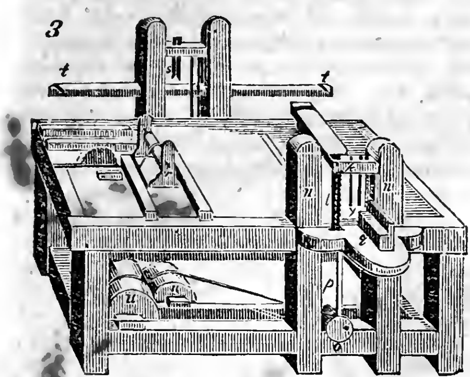


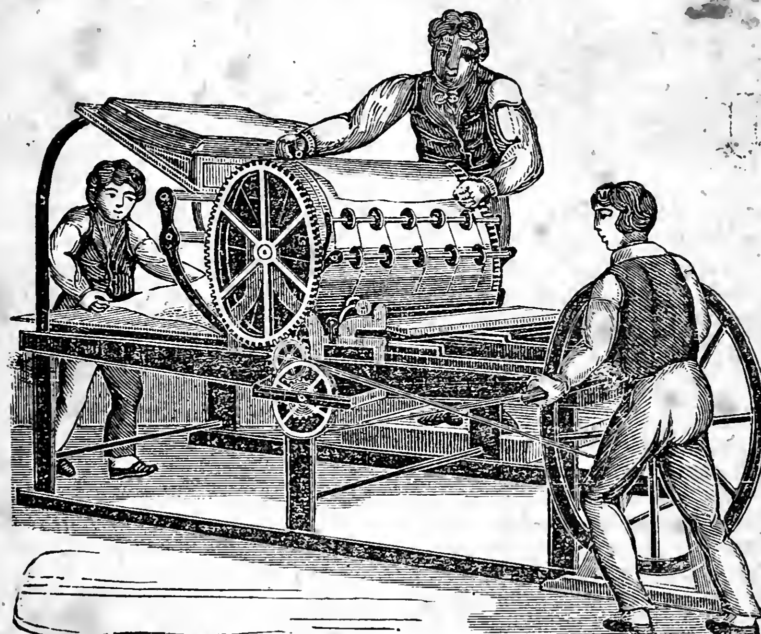
Fig. 3 represents a wooden frame of timber four inches by five inches square, eight feet long, six feet wide, and three feet high, to the top of the plates, with girts a sufficient height from the bottom to hang the drum-cranks, &c. on the frame. The following kind of work is done: the stuff, being planed, is taken to a small circular saw, *i*, set in motion on one end of the frame, and cut to an exact length by the aid of a wood slide gage, which can be set to any length, and can be screwed by set screws or keys. The next operation is tenoning: a small frame or gate, *k*, similar to a common saw gate, is fixed on the side of the large frame: in the top of the small frame are set two chisels, *y*, of sufficient length for tenoning small stuff; there are two saws, *l*, hung in the same gate or frame, for tenoning larger stuff for doors, &c. one of which can be used for dove-tailing, with proper gages. In the same gate or frame is hung an instrument, called a coper, *m*, which is constructed of a flat piece of steel, secured on just far enough forward to serve as a gage for cutting the coping sufficient deep to form a correct fit to the moulding of the sash. The gate, or small frame, is hung within two perpendicular posts, *n n*, screwed on the side of the main frame, on which posts are fastened two bars of round iron, polished, and fitted for the gate to slide on; immediately under this gate, and on the lower girts of the main frame, hangs an eccentric wheel, *o*, to which a pitman, *p*, is attached, which connects with the gate or frame in which the saws, chisels and coper, hang, and when put in quick motion by a strap or gearing is a very expeditious mode of making tenons, &c. This is done by passing the stuff along by the wooden gage, *q*, under the chisels, *y*, or up to the saws, *l*, as fast as they cut clear; a screw gage is fixed to regulate the length of the tenons; when large tenons are made by the saws, the shoulders are cut by a small circular saw, *i*, hung for that purpose at one end of the main frame, over which the stuff is passed by a wooden gage, so as to gage it just deep enough, and moveable at pleasure.

The boring is done by a spoon-bill bit fitted in a small arbor, *r*, set in motion at either side of the main frame, and is kept in its place by slide gages. The morticing is done on the opposite side of the main frame from the tenoning, by chisels, *s*, set in a similar frame and driven by a crank; the chisels are set transversely or crosswise, in order to leave a relish as in a mortice made by hand; one or more holes are bored to start from. The stuff is kept true to its place by slides or gages. The morticing is completed by passing the stuff along under the chisels, the same as in tenoning; a gage, *t*, is hung out at each end to govern the exact length of the mortice. One of these machines has been in successful operation for upwards of six months at Ithaca, Tompkins county. One man and two boys make, on an average, twelve hundred lights, seven by nine and eight by ten window sash, per week with ease, making the cost of the labor, allowing liberal wages to the hands employed, less than one cent per light.

The proprietors, Messrs. W. & J. Woodward, of Ithaca, will give any information on the subject, and offer to sell rights for large or small districts of country. These machines are about to be erected in the following counties: Courtlandt, Tioga, Steuben, Cayuga, Oneida, Jefferson, Genesee, and Orleans.

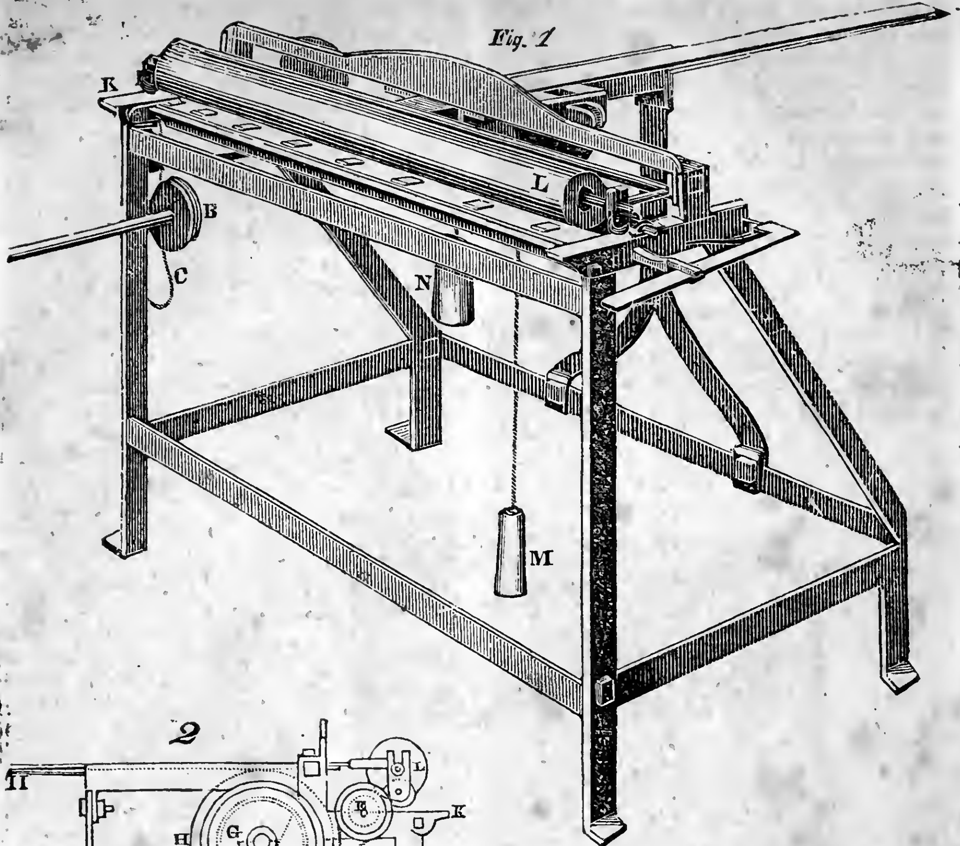
Sub-marine Boat.—In the course of last autumn, M. Villeroi, of Nantes, made a successful experiment at sea, off the island of Noirmoutier, with a locomotive sub-marine boat of an entirely novel construction. It is ten feet six inches in length, and three feet seven inches diameter in its greatest width. The machinery by which it is impelled is said to be a mechanical application of the forms and means with which nature has en-

dowed fish, and, in this instance, it is brought into play by the aid of steam. When the flux of the sea had attained its height, the inventor stepped into his boat, navigated for half an hour on the surface of the water, and then disappeared at a spot where the depth was between fifteen and eighteen feet, bringing up with him, on his re-appearance, a quantity of flints and a few shells. During his submersion he steered his boat in various directions, in order to deceive those who thought that they were following in his track, and rose at some distance from any of them. He then shifted his course repeatedly whilst navigating the surface; and at the termination of an hour and a quarter's practice, he threw off the cover which had protected and concealed him, and showed himself to the spectators amidst hearty cheers. It is obvious, from the success which attended this essay, that with the aid of M. Villeroi's ingenious machine, an individual may traverse a considerable distance under water with the same velocity as a common boat, and after calculating the depth to which he should plunge according to the density of the water, post himself under a ship's side for a hostile or other purpose, cut their cables asunder without being liable to detection, or descend for the recovery of wrecked stores, &c. The inventor was accompanied by two assistants, neither of whom suffered any inconvenience during their hour's submersion. The boat is constructed of iron.



Rutt's Printing Machine, made by Napier, (*Hoe's Improvement.*)—This machine is put in motion by hand labor; the engraving represents the carriage at the back part of the machine, with the form of type just after a sheet has been printed, and the lad at the back in the act of taking it away: the table or carriage then returns to the front of the machine, to receive the ink for the next impression, which is communicated from the ink receiver by several rollers, distributing the ink one from the other until it finally reaches the form upon the carriage by means of an elastic composition roller; in the mean time, another sheet is brought from the heap, sufficiently over the edge of the board (and not *on* the cylinder, as shown in the above cut,) to enable a range of grippers, that are fastened with springs upon the cylinder, to seize and convey it on the form as the carriage again passes under, when it receives the impression; and it is then delivered at the back of the machine as above. The carriage and cylinder are propelled by cogged wheels, as will be seen on reference to the cut—the former having a fly-wheel attached beneath it; and the inking apparatus is kept in motion by a cogged rail fastened on the carriage.

Fig. 1



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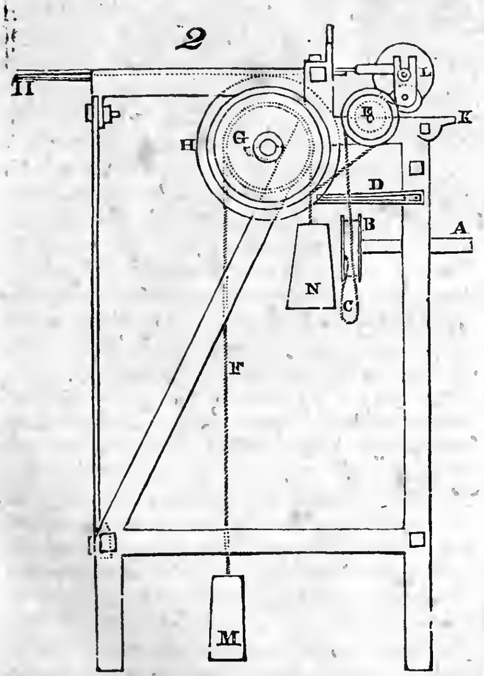


Patent Improved Ink Distributor.—We have been much pleased with inspecting and witnessing the operation of Messrs. Sabbaton & Spence's Patent Ink Distributor, in book printing, at the office of Mr. Dean, Frankfort street, in this city.

This machine, represented by the annexed plates, stands at the opposite side of the press to the workman, and receives its impulse from the rotary motion of the rounce, the shaft, A, of which is made long, passing to the end of the machine, where the pully, B, is fast; through the rim of this pully the end of the chord, C, is tied, and the other end, passing between a projection of iron, D, and a spring, is fastened to the loose pully, E, on the shaft of a wooden roller, as represented in figs. 1 and 2. This pully is attached by the same cord to pully G, on the end of the main shaft, that supports the pullies and weights in the centre of the frame, where a large loose pully, H, is connected by two catgut cords, II, passing in opposite directions to each end of the tail of the frame, K, that supports the composition roller, L.

On the side of the loose pully, H, is a

groove to receive the cord of the small weight, M; and on the other side a pully is fastened on the shaft, having a similar groove for the large weight, N, and on its periphery a catch tooth is held by a latch, to prevent the weight from falling until required; when, by raising the tympan, a flat piece of iron on its end presses a tripping rod inward, which raises the latch clear of the tooth, when a catch on the pully, H, takes its place, and, by the descent of the weight, N, both go round together, forcing the composition roller over the types.

Having performed a revolution, the tooth comes again in contact with the latch, and the catch, raising over an inclined plane on the latch, is freed, so that the small weight, M, being wound up by the descent of the large one, takes effect, and reversing the motion, brings the roller back to where it started.

The form is now run under the platen to receive the impression, and, by the connection of the pullies and cords before described, the large weight, N, is raised, while at the same time the wooden roller, together with a small vibrating distributor, and the composition roller, L, which rest upon it, are carried round by means of a catch on the loose pully, E, acting in a ratch tooth on the shaft of the wooden roller. This performs the act of distributing the ink for the impression.

The form is then removed from under the platen, which unwinds the cord off the pully on the rounce; but the projection, D, and spring, prevent it from throwing off the loose pully, E. The tympan being raised, the large weight performs the same operation as before described, winding up the slack cord on the loose pully, E, by means of the connection of the cord F, with the pully G, on the end of the main shaft; and by a snail on the same shaft, the small vibrating distributor is pressed down to a metal roller in the ink fountain, where the ink being regulated by a straight edge in four parts, and moved by eight screws, it receives the necessary supply.

The metal roller is turned round in the fountain by a catch on the frame of the small distributor, acting in a ratch wheel on its end.

Thus, by a simple compact piece of mechanism, the whole operation of distributing the ink for letter-press printing is well and accurately performed, with scarcely any additional labor to the workman.

Geological Course of Cholera.—Mr. Boubee has made some researches into the geology of the countries through which the Cholera has passed, from which he remarks that this epidemic has spread most speedily, and with its greatest intensity, through those distircts where the tertiary and alluvial earths are the most extensive, whilst it appears to have been propagated with great difficulty, to have lost its intensity, and even to have been extinguished in those parts where the older and particularly the primordial formations predominate. This coincidence of the course of the cholera with particular geological districts agrees with the observation pretty well established, that the circumstance of humidity and evaporation favor the developement of this disease. In fact, tertiary and alluvial earths have, to a remarkable degree, the property of imbibing water, which being again yielded by a prolonged evaporation, produces a humidity of the atmosphere entirely dependent on the nature of the soil. The older formations, on the contrary, compose ordinary compact rocks, which, being impermeable, can neither absorb moisture nor present it to the atmosphere by evaporation. Sometimes the old formations and volcanic depositions present rocks that are friable or decomposed in particular places, in which cases they will resemble the more recent ones in absorbing and affording moisture, and this circumstance may explain some of the exceptions to the general rule of the Cholera adhering in its progress to the modern formations.—[Jour. du Chimie Med.]

General Education.—It is pleasing to witness the simultaneous efforts that are being made in this country and in most parts of Europe to promote universal education. Here our Lyceums and institutions, for the promotion of science and literature, of all descriptions, are almost daily increasing, and as a proof of their prosperity we need only refer to a list of those at Boston, which will be found at page 250 of this Magazine. From the Quarterly Journal of Education, No. 10,* recently published by the "Society for diffusing Useful Knowledge," we extract a proposed course of instruction for "the children of the poorer classes:"

"Besides reading, writing, and arithmetic, the following subjects ought to be taught:

"*Reading* ought to be united with *history*. The best and first history, of course, is that of the pupil's native country, which should be written, we need hardly say, very differ-

* London, C. Knight, Pall Mall East.

ently from any book of the class yet published. A school library, stored with useful books, might afford inestimable advantages. And why should England see her labors for promoting knowledge and enlightening mankind turned to a better account in other countries than in her own?

"To *writing*, i. e. calligraphy and orthography, should be added lessons on the *general principles* and nature of *language*.

"*Elementary drawing*, which has been so often recommended, should certainly be a part of the education of all classes. It might be confined to the slate, and consist in teaching to draw straight and curved lines, with regular figures, accompanied by drawings composed of these lines and figures; and, finally, the pupil should draw various real objects. This branch of drawing proceeded from, and is cultivated in, Pestalozzian schools.

"The copying of pattern drawings and objects of nature must be chiefly left to the taste and opportunities of every individual pupil. The symmetrical figures, or compositions expressing merely symmetry, such as architectural ornaments, patterns of vessels, furniture, &c. need only be drawn on slates during the lesson, and may afterwards be copied at home into books with lead pencil, by those who show any taste and wish for it; and their books might occasionally be brought to school for the inspection of the master. There is little doubt that those who, after leaving school, enter trades, may derive the greatest advantages from those lessons of drawing, which develope and cultivate a taste for beauty and symmetry of form. Such practice would, undoubtedly, soon have a beneficial effect on all great branches of our national industry, where the taste of the workman is called into action.

"*Geography*, at least of their own country, and in the upper classes a general description of the globe, ought to be taught in all schools, with the aid of maps, &c., accompanied in each case with an account of the natural and manufactured products which characterise each country.

"*Arithmetic* is indispensable; and some elements of

"*Geometry* might be given in the drawing lesson.

"*Music* also should be taught. The objection that this is impracticable, because English boys, generally speaking, possess no ear for music, is quite groundless; for experience, in a sufficient number of instances to warrant a general rule, has proved the contrary to be the case. English boys are naturally quite as musical as German and French boys, and in Germany singing is taught in every school. Music was generally cultivated in England at one time, and it will again become general, and increase content and happiness, when the condition of the poorer classes will allow them a little more comfort and rational enjoyment than they now possess.

"*Religious* and *moral instruction* need not be particularly specified here; it is that on which the success of all other instruction chiefly depends.

"By what means the general instruction of the lower classes can be effected to the extent here briefly pointed out, is a question which belongs to the government to answer, and we hope they will soon speak out. This much may be said, that in the immense resources, and in the liberality and charitable character, of the English nation, there will be found sufficient means for establishing a school in every village throughout England and Wales, conducted on a plan similar to those in Germany, and particularly in Prussia. Parents ought to pay a trifle to prevent their undervaluing that which they can have for nothing. Boys ought to be compelled to attend these schools regularly, at least to their fourteenth, girls to their thirteenth year. No one who knows the English character will doubt that, if these village schools once obtained general esteem, there would be no want of exhibitions and prizes, &c. to enable the boy who showed distinguished abilities, and a good character, to go to a grammar school, and if he conducted himself well, to obtain any honor and advantages which education can confer."

The Society who put forth these sentiments contains among its committee many of the members of the British Cabinet, (including Lord Brougham as chairman,) and knowing, as every one must, the great zeal he displays in promoting General Education, we look with hope and confidence for some legislative enactment from the government, that shall place all the advantages here described within the reach of the most humble of the inhabitants of that country. The liberal principles they advocate will deter them from proposing any thing like compulsory measures, although we find an instance where such a plan has been and still is adopted; in the ninth number of the same Journal, the editor, alluding to the state of education at Saxe Weimar, says, "By a statute of the Grand

Duchy, every head of a family is *compelled* either to send his children to school, or else to prove that they receive adequate instruction under his own roof. Heavy penalties are attached to any breach of this statute, which is as old as the very infancy of Protestantism. In fact, it was designed as one of its safeguards; and even at the present day, it may be defended on the score of sound policy: for what means can be pointed out which are more admirably adapted to promote social order and individual happiness than universal education, in harmony with rational Christianity? The immediate effect of the statute in question is to establish a schoolmaster in every village and hamlet throughout the country. There is not so much as a secluded corner, with a dozen houses in it, without its schoolmaster. None, therefore, can urge the want of opportunity in excuse of the breach of the law; and unless the parent can adduce the proof which exempts him, he is bound to send his children to school after they have attained to their sixth year. Nay, more: in order that the enactment may not be evaded, the commissioner of each district makes a regular periodical report, to the municipal authorities, of the children in his district who have reached what may be termed their 'scholastic majority.' Even in the smallest villages, every child pays twelve groschen (about 1*s.* 6*d.*) a year to the master of the school. Though the amount is inconsiderable, it partakes of the nature of a tax on every head of a family, and it is obligatory upon him to pay it, unless his circumstances are extremely limited; in this case the district is bound to advance it. The master of the school makes out a list of the children in arrear of their fees every quarter, and transmits it to the Grand-ducal Government, by whom the amount is immediately advanced. The *minimum* of allowance to the master of a country school is $100 (15*l.*) a year, independently of lodging and firing; and that to the master of a town school is from 125 to 150 (19*l.* to 23*l.*), according to the size of the town. So soon as this *minimum* is exceeded, the instruction becomes gratuitous, and the district is no longer bound to pay up the quota for indigent children. There are, however, certain districts which are too poor to make any advances of that nature, and, in their case, recourse is had to the district church, which is in general possessed of monies, arising from ancient Catholic endowments, and is, therefore, expected to assist the district where the education of its inhabitants requires such aid. Again, where this resource does not exist, there is a public fund, called "*Landschulen-Fond*" (fund for country schools,) which assists the church, district, or families of the district, in completing the *minimum* of the master's allowance. This fund arises from voluntary donations, legacies, and the produce of certain dues which the state assigns to it, such as for dispensations in matters of divorce, or marriages between relatives, &c. This is the only portion of the expense which the state itself is called upon to contribute, and it is of very inconsiderable amount, though there are as many schools as villages in the Grand Duchy, and every master has a competent remuneration, as well as a claim to one half of his allowances in the season of old age or infirmity. Besides this there is a fund for the assistance of his widow and children, which has been raised out of his own statutory contributions of 2*s.* 3*d.* per quarter, and those of his colleagues; to which are added $350 a year from the State and Landschulen Fond; and certain dues laid aside for it by the Superior Consistory. All the national schools are under the superintendence of the local clergy, and the whole system is subject to the immediate control and direction of the Superior Consistory."

Such a system we should be sorry indeed to see allowed in any country; it is true the state as a state is not called upon to contribute greatly to its funds, but the Clergy and Consistory Court are clothed with too much power to suit our Republican notions.

Feats of M. Chaubert explained.—The feats sometimes performed by quacks and mountebanks, in exposing their bodies to fierce temperatures, may be easily explained on the principle here laid down. When a man goes into an oven raised to a very high temperature, he takes care to have under his feet a thick mat of straw, wool, or other non-conducting substance, upon which he may stand with impunity at the proposed temperature. His body is surrounded with air, raised, it is true, to a high temperature; but the extreme tenuity of this fluid causes all that portion of it in contact with the body, at any given time, to produce but a slight effect in communicating heat. The exhibitor always takes care to be out of contact with any good conducting substance; and when he exhibits the effect produced by the

oven in which he is enclosed upon other objects, he takes equal care to place *them* in a condition very different from that in which he himself is placed; he exposes them to the effect of metal or other good conductors. Meat has been exhibited, dressed in the apartment with the exhibitor; a metal surface is in such a case provided, and, probably, heated to a much higher temperature than the atmosphere which surrounds the exhibitor.

On Instinct.—In supplying the place of reason, instinct is perpetually assuming its semblance. Let us take an example or two from both the animal and the vegetable world.

In order that the seeds of plants should produce and perfect their respective kinds, it is necessary that their shoots rise to the surface of the earth to enjoy the benefit of light and air. Now, in whatever direction the eye of a seed, from which germination first radiates, is placed, these shoots ascend equally to the surface, either in curved or straight lines, according as such ascent may be most easily accomplished. Mr. John Hunter sowed a quantity of peas and beans with their eyes placed in different directions, in a tub, which he afterwards inverted, so that the bottom was turned uppermost, while the mould was prevented from falling out by a fine net. And in order that the under surface might possess a superior stimulus of light and heat to the upper, he placed looking-glasses around the mouth of the tub in such a way that a much stronger light was reflected upon the inverted mould than that of the direct rays of the sun; while, at the same time, he covered the bottom of the tub with straw and mats, to prevent the mould, in this direction, from being affected by solar influence. Yet the same instinctive law of ascent still prevailed. After waiting a considerable length of time, and perceiving that no shoots had protruded through the lower surface of the mould, he examined the contents of the tub, and found that they had all equally pressed upwards, and were making their way through the long column of mould above them, towards the reversed bottom of the vessel; and that where the eyes had been placed downwards, the young shoots had turned round so as to take the same direction. As one experiment leads on to another, he determined to try the effect of placing other seeds of the same kind in a tub, to which a rotatory motion should be given, so that every part of it might be equally and alternately uppermost, and the seeds should have no advantage in one direction over another. Here, as we often behold in other cases, the instinctive principle of accommodation was baffled by a superior power, and the different shoots, instead of ever turning round, uniformly adhered to a straight line, except where they met with a pebble, or any other resistance, when they made a curve to avoid such obstruction, and then resumed a straight line in the direction into which they were thereby thrown, without ever endeavoring to return to the original path.

"When a tree, which requires much moisture, (says Mr. Knight,) has sprung up or been planted in a dry soil, in the vicinity of water, it has been observed that much the larger portion of its roots has been directed towards the water; and when a tree of a different species, and which requires a dry soil, has been placed in a similar situation, it has appeared, in the direction given to its roots, to have avoided the water and moist soil."

"When a tree (remarks Dr. Smith) happens to grow from seed on a wall (and he particularly alludes to an ash in which the fact actually occurred,) it has been observed, on arriving at a certain size, to stop for a while and send down a root to the ground. As soon as this root was established in the soil, the tree continued increasing to a large magnitude."

The best means, perhaps, that a plant can possess of resisting the effect of drought, is a tuberous or a bulbous root. The grass called phleum *pratense*, or common catstail, when growing in pastures that are uniformly moist, has a fibrous root, for it is locally supplied with a sufficiency of water; but in dry situations, or such as are only occasionally wet, its roots acquire a bulbous form, and thus instinctively accommodates the plant with a natural reservoir. And there are various other grasses, as the alopecurus *geniculatus*, or geniculate foxtail, that exhibit the same curious adaptation.

Instinct may therefore be defined to be the operation of the principle of organized life by the exercise of certain natural powers directed to the present or future good of the individual; and reason, the operation of the principle of intellectual life, by the exercise of certain acquired powers directed to the same end. Both equally answer their object, are equally perfect in their kind, and equally display their common origin.

Instinct, however, has as often been confounded with *feeling*, or *sensation*, as it has with *perception*, which is the outline or foundation of reason; and hence another source of those perplexities and errors in distinguishing between animal and vegetable life—perplexities and errors which have been productive of the most absurd and disgusting consequences, and especially in regard to the delicate and elegant science of botany.

Instinct, sensation, and perception, are all principles essentially different; they may, indeed, exist conjointly, but each of them is capable of existing separately. Instinct is the common law or property of organized matter, as gravitation is of unorganized; and the former bears the same analogy to sensation and perception as the latter does to crystalization and chemical affinity. Instinct is the general faculty of the organized mass as gravitation is on the unorganized mass; sensation and perception are peculiar powers or faculties appertaining to the first, as crystalization and affinty are appertaining to the second; they can only exist under certain circumstances of the organized or unorganized matter to which they respectively belong.

Whence derive the young of every kind a knowledge of the peculiar powers that are to appertain to them hereafter, even before the full formation of the organs in which those powers are to reside? To adopt the beautiful language of the first physiologist of Rome,

> The young calf whose horns
> Ne'er yet have sprouted, with his naked front
> Butts when enraged: the lion-whelp or pard
> With claws and teeth contends, ere teeth or claws
> Scarce spring conspicuous: while the pinion'd tribes
> Trust to their wings, and, from th' expanded down,
> Draw, when first fledged, a tremulous defence.

In like manner an infant, in danger of falling from its nurse's arms, stretches out its little arms to break the fall, as though acquainted by experience with such an action. We here meet with an instance of pure instinct; but we pursue the same conduct in adult age, and we have then an example of instinct combined with intelligence; and intelligence, instead of opposing the instinctive exertion, encourages and fortifies it. So when caterpillars, observes Mr. Smellie, are shaken from a tree, in whatever direction they descend, they all instantly turn towards the trunk and climb upwards, though till now they have never been on the surface of the ground.

The vegetable kingdom offers us examples of simple instinct equally singular and marvellous. Thus the stalk of the convolvulus twines towards the south; the phraseolus *vulgaris*, or kidney bean, pursues the same course: while the honey-suckle and the hop take a perfectly reverse direction. Who will reveal to us the cause of these differences?

Let us close these observations with a momentary glance at the very singular instinctive powers of the cancer *ruricola*, or land-crab. This is an inhabitant of the tropical regions, and especially of the Bahama Islands: it is gregarious, and associates in large bodies, that preserve an orderly society, for the most part in the recesses of inland mountains, though they regularly once a year march down to the sea-side in an army of some millions to deposit their spawn in the ocean. The time selected for this expedition is usual in the month of May, when they sally forth from the stumps of hollow trees, the clefts of rocks, and subterraneous burrows, in enormous multitudes. The whole ground, indeed, is covered with this reptile band of adventurers; and no geometrician could direct them to their destined station by a shorter course. They turn neither to the right hand nor to the left, whatever be the obstacles that intervene; and if they meet with a house, they will rather attempt to scale the walls than relinquish the unbroken tenor of their way. Occasionally, however, they are obliged to conform to the face of the country; and if it be intersected by rivers, they pursue the stream to its fountain head. In great dearth or rain they are compelled to halt, when they seek the most convenient encampment, and remain there till the weather changes. They make a similar halt when the sun shines with intense heat, and wait for the cool of the evening. The journey often takes them up three months before they arrive on the sea coast; as soon as they accomplish which, they plunge into the water, shake off their spawn upon the sands, which they leave to nature to mature and vivify, and immediately measure back their steps to the mountains. The spawn, thus abandoned, are not left to perish: the soft sands afford them a proper nidus; the heat of the sun and the water give them a birth; when millions of little crabs are seen crawling to the shore, and exploring their way to the interior of the country, and thus quitting their elementary and native habitation for a new and untried mode of existence. It is the marvellous power of in-

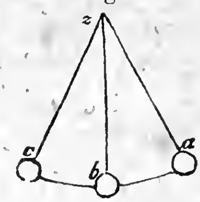
stinct that alone directs them, as it directed the parent hosts from whom they have proceeded; that marvellous power which is coextensive with the wide range of organic life, universally recognised, though void of sensation; consummately skilful, though destitude of intelligence; demanding no ground or developement of faculties, but mature and perfect from its first formation.

The general corollary resulting from these observations is as follows: that instinct, as I have already defined it to be, is the operation of the principle of organized life by the exercise of certain natural powers directed to the present or future good of the individual; while reason is the operation of the principle of intellectual life by the exercise of certain acquired powers directed to the same object: that it appertains to the whole organized mass, as gravitation does to the whole unorganized; equally actuating the largest and smallest portions, the minutest particles and the bulkiest systems, every organ and every part of every organ, whether solid or fluid, so long as it continues alive: that, like gravitation, it exhibits under particular circumstances different modifications, different powers, and different effects; but that like gravitation, too, it is subject to its own division of laws, to which under definite circumstances, it adheres without the smallest deviation; and that its sole and uniform aim, whether acting generally or locally, is that of perfection, preservation, or reproduction.

Of this mode of existence we know nothing: but as little do we know of the principle of gravitation of mind. We can only assure ourselves that they are distinct powers, perhaps distinct essence; and we see them acting, as well separately as conjointly, for the general good. Under their accordant influence we behold the plastic and mysterious substance of matter, which we must be especially careful not to confound with themselves, rising from "airy nothing" into entity: ascending from invisible elements into worlds and system of worlds; from shapeless chaos and confusion, into form, and order, and harmony; from brute and lifeless immobility, into energy and activity; into a display of instinct, feeling, perception; of being, and beauty, and happiness. One common design, one uniform code of laws, equally simple and majestic, equally local and comprehensive, pervades, informs, unites, and consummates the whole. The effect then being one, the mighty cause that produced it must be one also; an eternal and infinite unity—the radiating fountain of all possible perfections —ever active, but ever at rest—ever present, though never seen—immaterial, incorporeal, ineffable: but the source of all matter, of all kind, of all existences, and all modes of existence. Whatever we behold is God—all nature is his awful temple—all sciences the porticoes that open to it: and the chief duty of philosophy is to conduct us to his altar; to render all our attainments, which are the bounteous afflations of his spirit, subservient to his glory, and to engrave on the tablet of our hearts this great accordant motto of all natural and all revealed religion, of Athens and of Antioch, of Aratus and of St. Paul, "in him we live, and move, and have our being."—[Good's Book of Nature.]

Specification of a Patent granted to Richard Badnall, Junr. of England, for inventing a Propelling Power to enable Engines to ascend Hills on Railroads. [From the Repertory of Inventions, &c.]

Fig. 1.



My improvement in the construction or formation of the trams or rails, or lines of rail or tram roads, will be best illustrated by reference to the oscillation of a pendulum.

If a plummet, suspended by a string, as fig. 1, from the point z, be drawn away from the perpendicular line to the point a, and there let go, it will fall by its gravity in the arc, $a\ b$, but in its falling it will have acquired so much momentum as will carry it forward up to a similar altitude at the point c.

Let it be supposed that a line of rails or tram-way for carriage be so constructed from the summit of two hills, as fig. 2, across a valley, that the descent from one hill, as a, to the valley b, shall subtend a similar angle up the other hill, from the horizontal

line to the ascent up the hill, from b to c. Now, if a tram waggon, as d, be placed at the summit of the declivity a, it will, by its gravity alone, run down the descending line of rails to the lowest point b; but in so running, according to the principle of the oscillating pendulum, it shall have acquired a momentum that would carry it forward without any additional force, up the ascending line, to the summit of the hill, c, being at the same altitude as the hill, a. It is quite certain that this would really take place if the force acquired by the momentum was not impeded by the friction of the wheels of the carriage upon their axles, and upon the rails on which they run.

Hence subtracting the amount of friction as a retarding force from the momentum which the carriage has acquired in descending from a to b, it will be perceived that the force of momentum alone would only impel the carriage part of the way up the ascent b c, say as far as z. It must now be evident that the carriage d would not only pass down the descending line of road from a to b by its gravity, but the momentum acquired in the descent would also impel it up the second hill as far as z, unassisted by any locomotive power. In order, therefore to raise the carriage to the top of the second hill, I have only to employ such an impelling force as would be sufficient to draw it from z to c. If I employ a locomotive power to assist in impelling my carriage from a to b, I by that means obtain a greater momentum than would result from the descent of the carriage by gravity alone; and am enabled by that means to surmount the hill c, having travelled the whole distance from a to c on the undulating line of road, with the exertion of much less locomotive power than would have been requisite to have impelled the carriage the same distance upon a perfectly horizontal plane.

I claim as my invention the form of tram or rails, or lines of tram or rail road, in such undulating curve or curves as will enable me, in ascending hills, to combine and apply the advantages of momentum from gravity acquired in running down the descending curves of hills, with the propelling power of locomotive engines to be employed thereon, not confining myself to any particular extent of line or form of curve, but varying and adapting the curve or curves according to the surface of the country, or other local circumstances.

In witness, &c.

Improved Carriage Wheel Guard. [Communicated by the Inventor for the Mechanics' Magazine.]

Middleburg, Md. May 10, 1833.

Sir,—Having been informed that your paper is exclusively devoted to the publication of all new and important information connected with discoveries in mechanics, I have taken the liberty of inclosing you a description of my "Carriage Wheel Guard," an apparatus for which I have received "Letters Patent" from the Government of the United States. With this apparatus attached to wheeled carriages of all kinds, there is perfect safety and security from the occurrence of accident in case any derangement should take place in the running part. The great advantages to be derived by the travelling portion of the community, from the general introduction of this "Carriage Wheel Guard," must be obvious to the most superficial observer. Respectfully yours,

W. Zallickoffer, M. D.

Description.—This apparatus consists of a cylindrical flanged rim of iron, guards, a circular collar, and a semi-circular cap. The axle-tree and wheels are made in the usual manner. The cylindrical flanged rim of iron is either cast whole with the hub, or in sections, and screwed to its periphery in a groove, having two flanges, one on each side, raised sufficiently high to form a groove to receive the collar. The guards are made of iron, nearly in the form of the letter Z, and secured to the axle-tree by a joint and screw bolt. To each axle-tree there are four guards, two on each side. The circular collar, made of iron, is secured to the ends of the guards, and is put around the cylindrical rim in the groove formed by the flanges. A semi-circular cap, secured to the guards by hooks and staple, is put over the hub to prevent dirt falling in the groove around the rim. There are three other modes of applying the same principle described in the specification, which it is, perhaps, unnecessary here to notice, as they are not as likely to answer the purpose quite as well as the present described apparatus.

Operation.—The operation is thus:—When the axle-tree is whole, and the linch-pin, or nut, secure, then the wheel turns without touching any part of the guards or collar; but should the spindle of the axle-tree break, or the linch-pin or nut become disengaged, then the wheel would be pre-

vented from falling by the cylindrical collar on the ends of the guards put around the hub, between the flanges of the rim, as before described, and the wheel would continue to revolve, without any impediment except that created by the friction of the collar and rim. Should the axle-tree break at the shoulder of the spindle, or in any other part, the wheel will still be preserved in its ordinary position, but will become partially locked from the friction of the collar.—For a further illustration of my invention, I refer to the model and drawings of the same, deposited in the Patent Office, and to those (if more convenient) in my possession also.

Working Man's Companion. The Result of Machinery, namely, Cheap Production and Increased Employment, being an Address to the Working Men of the United Kingdom. Philadelphia, 1831, Carey & Hart, 18mo. pp. 215.

There is, perhaps, no more striking instance of the erroneous reasoning of a great portion of the civilized world, than that against the utility of labor-saving machines. Many suppose the tendency of those improvements that cheapen the products of the soil and arts is to lessen employment, and thereby become an injury to mankind; and when they can refer to what they have heard, seen, and experienced, they consider themselves infallibly right, yet nothing is further from the truth. They reason like the inhabitants of a valley whose horizon has for a long and tedious while been bounded by chilling and blasting clouds of rain and sleet, not believing that over all the country besides the sun is diffusing its genial and vivifying rays.

The book before us was published under the superintendence of the Society for the Diffusion of Useful Knowledge, and was occasioned by the destruction of agricultural machinery by the laboring classes in Great Britain. The object was to show them that in destroying labor-saving machines they were diminishing the sources of employment. Deeming it important that correct views should be as generally as possible entertained on this subject, we shall make a few extracts, which we trust our readers will find interesting. That in reference to printing, illustrates the effects of all similar improvements:

"It is about 350 years since the art of printing books was invented. Before that time all books were written by the hand. There were many persons employed to copy out books, but they were very dear, although the copiers had small wages. A Bible was sold for thirty pounds in the money of that day, which was equal to a great deal more of our money. Of course very few people had Bibles, or any other books. An ingenious man invented a mode of imitating the written books by cutting the letters on wood, and taking off copies from the wooden blocks by rubbing the sheet on the back; and soon after other clever men thought of casting metal types or letters, which could be arranged in words and sentences, and pages and volumes; and then a machine called a printing press, upon the principle of a screw, was made to stamp impressions of these types so arranged. There was an end, then, at once, to the trade of the pen and ink copiers; because the copiers in types, who could press off several hundred books while the writers were producing one, drove them out of the market. A single printer could do the work of at least two hundred writers. At first sight this seems a hardship, for a hundred and ninety-nine people might have been, and probably were, thrown out of their accustomed employment. But what was the consequence in a year or two? Where one written book was sold, a thousand printed books were required. The old books were multiplied in all countries, and new books were composed by men of talent and learning, because they could then find numerous readers. The printing press did the work more neatly and more correctly than the writer, and it did it infinitely cheaper. What then? The writers of books had to turn their hands to some other trade, it is true; but type-founders, paper-makers, printers, and book-binders, were set to work, by the new art or machine, to at least a hundred times greater number of persons than the old way of making books employed. If the pen and ink copiers could break the printing presses, and melt down the types that are used in London alone at the present day, twenty thousand people would at least be thrown out of employment to make room for two hundred at the utmost; and what would be even worse than all this misery, books could only be purchased, as before the invention of printing, by the few rich, instead of being the guides and comforters, and best friends, of the millions who are now within reach of the benefits and enjoyments which they bestow."

The following dilemma respecting the

horse churn justly excites risible emotions, and burlesques the deluded laborers themselves:

"Amongst the many accounts which the newspapers of December, 1830, give of the destruction of machinery by agricultural laborers, we read that, in the neighborhood of Aylesbury, a band of mistaken and unfortunate men destroyed all the machinery of many farms, *down even to the common drills.* The men conducted themselves, says the country newspapers, with civility; and such was their consideration, that they moved the machines out of the farm yards, to prevent injury arising to the cattle from the nails and splinters that flew about while the machinery was being destroyed. They *could not make up their minds* as to the propriety of destroying a horse churn, and therefore that machine was passed over. * * *

"Why should the laborers of Aylesbury not destroy the harrows as well as the drills? Why leave a machine which separates the clods of the earth, and break one which puts seeds into it? Why deliberate about a horse-churn, when they are resolved against a winnowing machine?"

The truth is, every implement or tool was once a *new* labor-saving machine.

"The chief distinction between man in a rude and man in a civilized state of society is, that the one wastes his force, whether natural or acquired,—the other economises, that is, saves it. The man in a rude state has very rude instruments—he therefore wastes his force: the man in a civilized state has very perfect ones—he therefore economises it. Would you not laugh at the gardener who went to hoe his potatoes with a stick, having a short crook at the end? It would be a tool, you would say, fit only for children to use. Yet such a tool was doubtless employed by some very ancient nations; for there is an old medal of Syracuse which represents this very tool. The common hoe of the English gardener is a much more perfect tool, because it saves labor. Could you have any doubt of the madness of the man who would propose that all iron hoes should be abolished, to furnish more extensive employ to laborers who should be provided only with a crooked stick cut out of a hedge? The truth is, if you, the working men of England, had no better tools than crooked sticks, you would be in a state of actual starvation. One of the chiefs of the people of New-Zealand, who, from their intercourse with Englishmen, had learnt the value of tools, told Mr. Marsden, a missionary, that his wooden spades were all broken, and he had not an axe to make any more; his canoes were all broken, and he had not a nail or a gimlet to mend them with; his potato grounds were uncultivated, and he had not a hoe to break them up with; and that *for want of cultivation*, he and his people would have nothing to eat. This shows you the state of a people without tools."

The effects of roads have a very great and decided tendency to advance the state of society:

"At Abbeyfeale and Brosna about half of the congregation at mass on Sundays were barefoot and ragged, with small straw hats of their own manufacture: felt hats being worn only by a few. Hundreds or even thousands of men could be got to work for sixpence a day, if it had been offered. The farmers were mostly in debt, and many families went to beg in Tipperary and other parts. The condition of the people is now very different; the congregations at the chapels are now as well clad as in other parts; the demand for labor is increased, and a spirit of industry is getting forward, since the new roads have become available."

To form a correct view of what constitutes labor-saving machinery, we must go back to the more simple condition of mankind. Our work says,

"We once met an old woman in a country district, tottering under the weight of a bucket, which she was laboring to carry up a hill. We asked her how she and her family were off in the world. She replied that she could do pretty well with them, for they could all work, if it were not for one thing—it was one person's labor to fetch water from the spring; but, said she, if we had a pump handy, we should not have much to complain of. This old woman very wisely had no love of labor for its own sake; she saw no advantage in the labor of one of her family being given for the attainment of a good, which she knew might be attained by a very common invention. She wanted a machine to save that labor. Such a machine would have set at liberty a certain quantity of labor which was previously employed unprofitably; in other words, it would have left her or her children more time for more profitable work, and then the family earnings would have been increased."

The next extract we make shows in a very striking manner how much the condition and employment of the whole world are affected by

the introduction of some simple machinery into a distant country:

"The creation of employment amongst ourselves by the cheapness of cotton goods produced by machinery is not to be considered as a mere change from the labor of India to the labor of England. It is a creation of employment, operating just in the same manner as the machinery did for printing books. The Indian, it is true, no longer sends us his calicoes and his colored stuffs; we make them ourselves. But he sends us forty times the amount of raw cotton that he sent when the machinery was first set up. In 1781 we imported five million pounds of cotton wool. In 1828 we imported two hundred and ten million pounds—enough to make twelve hundred and sixty million yards of cloth—which is about two yards apiece for every human being in the world. The workman on the banks of the Ganges, (the great river of India,) is no longer weaving calicoes for us, in his loom of reeds under the shade of a mango tree; but he is gathering for us forty times as much cotton as he gathered before, and making forty times as much indigo for us to color it with. The export of cotton has made such a demand upon the Indian power of labor, that even the people of Hindostan, adopting European contrivances, have introduced machinery to pack the cotton. Bishop Heber says, that he was frequently interested by seeing, at Bombay, immense bales of cotton lying on the piers, and the ingenious screw, by which an astonishing quantity is pressed into the canvas bags. The Chinese, on the contrary, from the want of these contrivances to press the cotton so close in bags, sell their cotton to us at much less profit; for they pack it so loosely that it occupies three times the bulk of the Indian cotton, and the freight costs twelve times the price on this account. When the Chinese acquire the knowledge from other nations, which their institutions now shut out, they will know the value of mechanical skill, in preference to unassisted manual labor."

It is asserted by this British work, that, "we buy three million and a half pounds of raw silk from the stranger, employ half a million of our own people in the manufacture of it by the aid of machinery, and sell it to the stranger, and to our own people, at a price as low as that of the calico of half a century ago." The time will soon come when half a million of the people of the United States will be employed in rearing the silk worm, and in manufacturing silk.

"There is an article employed in dress, which is at once so necessary and so beautiful that the highest lady in the land uses it, and yet so cheap that the poorest peasant's wife is enabled to procure it. The quality of the article is as perfect as art can make it; and yet, from the enormous quantities consumed by the great mass of the people, it is made so cheap that the poor can purchase the best kind, as well as the rich. It is an article of universal use. United with machinery, many hundreds, and even thousands, are employed in making it. But if the machinery were to stop, and the article were made by human hands alone, it would become so dear that the richest only could afford to use it; and it would become, at the same time, so rough in its appearance, that those very rich would be ashamed of using it. The article we mean is a *pin*."

Contrary to the impressions of many, it is a fact, as mankind progress in civilization their lives are prolonged. It is easy to see that science, philanthropy, and religion, will still continue to increase the number of years allotted to man:

"Savages, it is well known, are not long livers; that is, although there may be a few old people, the majority of savages die very young. Why is this? Many of the savage nations that we know have much finer climates than our own; but then, on the other hand, they sustain privations which the poorest man amongst us never feels. Their supply of food is uncertain, they want clothing, they are badly sheltered from the weather, or not sheltered at all, they undergo very severe labor when they are laboring. From all these causes savages die young. Is it not reasonable, therefore, to infer that if in any particular country the average duration of life goes on increasing, that is, if fewer people, in a given number and a given time, die now than formerly, the condition of that people is improved; that they have more of the necessaries and comforts of life, and labor less severely to procure them? Now let us see how the people of England stand in this respect. The average mortality in a year, about a century ago, was reckoned to be one in thirty; fifty years ago it was one in forty: thirty years ago one in forty-seven; twenty years ago one in fifty two: and now it is one in fifty-eight. You see, therefore, according to this estimate, of which there is no reason whatever to doubt the accuracy, that where one person dies in a year now,

two died a century ago. This remarkable result is doubtless produced in some degree by improvements in the science of medicine, and particularly by the use of inoculation for the small pox, and vaccination. But making every allowance for these benefits, the fact furnishes the most undeniable truth, that the people of England are infinitely better fed, clothed, and lodged, than they were a century ago, and that the labor which they perform is infinitely less severe."

Our limits will not permit us to do ample justice to this little volume; we must, however, find space for one more extract, which we most heartily recommend to the particular notice of our readers:

"The first thing that we say to every working-man is, get knowledge. By knowledge, we do not mean the arts alone of reading and writing, which are only the keys to knowledge, but that sound practical acquaintance with the elements of science, both moral and physical, which may give working-men a right knowledge of the things by which they are surrounded, and enable them to form a right estimate of their own capabilities and their own duties. By knowledge, neither do we mean only that acquaintance with books which refines and elevates the mind, but an acquaintance with every thing about them, and especially with the mechanical arts which properly belong to, or are allied with, their own trade. The first employment which we ask them to make of this practical knowledge is to acquire the readiness of shifting their occupation. It is not the increase of machinery, or the occasional glut of laborers, which alone compel the working-man to pass through a state of change. The caprices of fashion, which, upon the whole, create employment, also make that employment irregular. A change from metal buttons to silk buttons is alone sufficient to derange the industry of hundreds of workmen. What then is the remedy? Knowledge. The power of knowing what employments are in any degree allied to your own employments, and how your own employments may receive a new impulse from your own ingenuity. There are constant fluctuations, for instance, between the demands for silk and the demands for cotton. The spinners and weavers have learnt to adapt themselves to these fluctuations. At Manchester, at the present moment, there are twenty thousand men working at silk, who, two years ago, were working at cotton. We have seen how the lace-makers of Marlow, instead of struggling against the lace machine, applied themselves to embroider caps. In both these cases, these salutary changes of employment could not have been effected without a certain degree of knowledge. But the great advantage of such practical knowledge to you all is that you may strike out new sources of industry. Whenever you can do a thing better,—that is, when you can improve the quality of an article, and add to its cheapness,—you may be sure of creating a demand for it."

If our practical men will but follow the excellent advice here given, they will soon obtain their share of all those blessings which industry and science confer on mankind; and, to use the words of the eloquent Dr. Chalmers, "it will come through the medium of a growing worth and growing intelligence among the people. It will bless and beautify that coming period when a generation, humanized by letters, and elevated by the light of Christianity, shall, in virtue of a higher taste and a larger capacity than they now possess, cease to grovel among the sensualities of a reckless dissipation."

SOCIETIES FOR PROMOTING USEFUL KNOWLEDGE, IN BOSTON, MASS.—In Boston there are not less than fifteen institutions, with more or less of the nature and objects of Lyceums. The Mechanics' Association, which is the oldest institution of the kind in the city, has, as every Lyceum ought to have, benevolence for a part of its object. Besides the distribution of charity, it has had for several years a weekly course of lectures during the winter, which for the last season have been numerously attended by ladies as well as gentlemen. According to the constitution of this association, the members must be master mechanics.

The Mechanics' Institution has been in operation five or six years, and is furnished with a valuable set of apparatus at an expense of two or three thousand dollars. Since its organization, a course of lectures has been given annually, by gentlemen of extensive attainments in science and literature. To the lectures during the last season, ladies have been invited.

The Society for the Diffusion of Useful Knowledge has been organized about four years; since which time they have had an annual course of lectures on various subjects, which have been numerously attended. Several volumes have been published under the

patronage of this society, entitled The American Library of Useful Knowledge.

A Society for Natural History was organized about two years since, and have had three courses of lectures on the different departments of Natural History, highly acceptable to the auditors and spectators. This society is in a prosperous condition, and is soon to be furnished with commodious rooms for depositing their collections.

The Franklin Lectures have been given for two seasons, and very numerously attended.

The Young Men's Association for the Promotion of Literature and Science, though smaller in number than those already mentioned, is not less profitable or interesting to its members.

The Young Men's Benevolent Society unites literary improvement with aiding the poor, which is its principal object. It has been highly useful, and is now in a state of increasing prosperity.

The Boston Young Men's Society for Intellectual and Moral Improvement, which was organized but a few months since, has procured a respectable library and a commodious hall, and other rooms, where young men, especially strangers, are invited to resort, and where they are placed under the most favorable circumstances for social entertainment, by forming valuable acquaintances and enjoying good society, while they have great facilities for intellectual improvement.

The Boston Lyceum has had increasing prosperity since its first organization, four years since. It is distinguished from most or all the societies already named, by its being divided into various classes, for special objects, such as Natural Philosophy, Astronomy, Mathematics, Elocution, French Language, &c. It is also distinguished by their applying to none, or but a few, except the members of the society, for public lectures, which have been highly respectable, and given for four seasons.

The Mechanics' Lyceum, though from its object and constitution it is not large, has been highly successful in bringing forward young men to feel and exert their own powers, which has, of course, resulted in the true elevation of character, of most if not all its members. The plan of this Lyceum is to have all the members take a part in its exercises.

Among other results of the Mechanics' Lyceum, is a periodical under the name of the Young Mechanic, which is eminently of a practical and useful character, and has a growing patronage and popularity.

Another society which is not less deserving or prosperous than either of those already mentioned, is the Mechanic Apprentices' Library Association. This society was originally connected with the Mechanics' Charitable Association, the one first mentioned; but for a year or two past it has been independent of its parent, and has set up business for itself, and has found, by its greatly increased prosperity, that it is quite competent to carrying it on. Besides the library, which is large, it has some apparatus, and has recently commenced a cabinet of natural and artificial productions.

A weekly course of lectures by the apprentices themselves is well sustained, and sufficiently interesting and attractive to draw full meetings of ladies and gentlemen. This society has classes, especially for the younger members to become acquainted with the common and practical branches of education. It is particularly worthy of remark, that since meetings for lectures and study have been held, a greatly extended and increased interest has been given to the library. Books of a certain class, which before were scarcely taken from the shelves from one year to another, have now become the most interesting as well as the most useful in the library. At a late anniversary of this Apprentices' Lyceum, an orator and a poet, both from their number, furnished an entertainment to a crowded hall of ladies and gentlemen, which would have done credit to older heads and more regularly trained scholars. This society has set an example worthy to be followed by any Lyceum in any place. Many Lyceums of a social character have been fraught with advantages of the highest value.

Social Lyceums. It may well be doubted if the social, the intellectual, the refined, the amiable, and the moral qualities of our nature have ever been more beautifully blended, or more happily exhibited, than in some small circles of ladies and gentlemen, associated for the double purpose of social intercourse and intellectual improvement. Free from the empty ceremony and the heartless compliments of fashionable parties, and the restraint and formality of large assemblies, they enjoy all the advantages of the one without the evils of the other. They are sufficiently free and unrestrained to be social and animated, and sufficiently formal to confine the conversation within certain limits

and to render it in the highest degree entertaining and instructive.

Ten Rules to be observed in Practical Life.—The following rules were given by the late Mr. Jefferson, in a letter of advice to his namesake, Thomas Jefferson Smith, in 1825:—

1. Never put off till to-morrow what you can do to-day.
2. Never trouble others for what you can do yourself.
3. Never spend your money before you have it.
4. Never buy what you do not want because it is cheap.
5. Pride costs us more than hunger, thirst, and cold.
6. We never repent of having eaten too little.
7. Nothing is troublesome that we do willingly.
8. How much pains have those evils cost us which never happened.
9. Take things always by their smooth handle.
10. When angry, count ten before you speak—if very angry, a hundred.

The Crafts of Germany.—The different crafts in Germany are incorporations recognised by law, governed by usages of great antiquity, with a fund to defray the corporate expenses, and, in each considerable town, a house of entertainment is selected as the house of call, or harbor, as it is styled, of each particular craft. Thus you see in the German towns a number of taverns indicated by their signs, as the Masons' Harbor, the Blacksmiths' Harbor, &c. No one is allowed to set up as a master workman in any trade, unless he is admitted as a freeman or member of the craft; and such is the stationary condition of most parts of Germany, that no person is admitted as a master workman in any trade, except to supply the place of some one deceased, or retired from business. When such a vacancy occurs, all those desirous of being permitted to fill it present a piece of work, executed as well as they are able to do it, which is called their master-piece, being offered to obtain the place of a master workman. Nominally, the best workman gets the place; but you will easily conceive, that, in reality, some kind of favoritism must generally decide it. Thus is every man obliged to submit to all the chances of a popular election, whether he shall be allowed to work for his bread; and that, too, in a country where the people are not permitted to have any agency in choosing their rulers. But the restraints on journeymen, in that country, are still more oppressive. As soon as the years of apprenticeship have expired, the young mechanic is obliged, in the phrase of the country, to *wander* for three years. For this purpose he is furnished, by the master of the craft in which he has served his apprenticeship, with a duly-authenticated wandering book, with which he goes forth to seek employment. In whatever city he arrives, on presenting himself with his credential, at the house of call, or harbor, of the craft in which he has served his time, he is allowed, gratis, a day's food and a night's lodging. If he wishes to get employment in that place, he is assisted in procuring it. If he does not wish to, or fails in the attempt, he must pursue his wandering; and this lasts for three years before he can be anywhere admitted as a master. I have heard it argued, that this system had the advantage of circulating knowledge from place to place, and imparting to the young artisan the fruits of travel and intercourse with the world. But, however beneficial travelling may be, when undertaken by those who have the taste and capacity to profit by it, I cannot but think that, to compel every young man who has just served out his time to leave his home, in the manner I have described, must bring his habits and morals into peril, and be regarded rather as a hardship than as an advantage. There is no sanctuary of virtue like home.—[From Everett's Address.]

Smoky Chimnies.—He that can keep his body warm, and his temper cool, in a smoky room, in a cold, stormy, winter's day, has less of poor human nature in his composition than most men. Of all the evils "that flesh is heir to," deliver us from a smoky house, and its concomitants, a scolding wife, and ill-natured, peevish, squalling children. Some chimnies draw well except when the wind comes from a particular quarter; but the moment it veers round, and gets into that quarter, down it comes, puff after puff, and the whole house is immediately filled with smoke; from this there is no possibility of escaping unless one flees to the street and encounters the pelting storm, or, which is still worse, resorts to the neighboring tavern, and there, like Tam O'Shanter, plants himself "fast by the ingle, bleezing finely."

These kind of chimnies can be remedied by the following apparatus. Over the top of the chimney fix an upright iron pipe, like that of a stove-pipe, only larger, so that it will turn easily; to the top of this, and at right angles with it, attach another, open at both ends, and having a communication between the two; inside of this last must be inserted a trumpet-shaped tube, the large end of which must just fit, and be fastened to the pipe, in which it is inserted, and the small end extended over and beyond the mouth of the first, or perpendicular pipe, but not quite to the end of the one in which it is inserted. It must be remarked, that the top or horizontal pipe should be so attached to the perpendicular one as to have what we may call the escape end extend from it considerably farther than the mouth end. To complete the apparatus, attach a piece of sheet-iron to the escape end of the horizontal pipe, large enough to cause the whole to traverse like a vane, by which means the mouth will always be presented to the wind, and a current passing through the trumpet-shaped tube, over and beyond the flue of the chimney, which will produce a draught, and carry off the smoke. With this apparatus, provided it traverses well, it is impossible that a current of air can ever get into and pass down the chimney, while a current proportioned to the strength of the wind will always be passing over the top of the chimney, and forcing the smoke off as it rises.

Mutual Instruction.—The following account of a Literary Society, the members of which belong to the working class, is condensed from a paper addressed to the proprietors of large manufactories by the Secretary of the Glasgow Chamber of Commere.

It is justly remarked by this gentleman that the mere acquisitions of reading and writing only serve to open the door to knowledge; and, unless we are induced to pass the portal, the stores which lie within will still remain useless to us. No efforts, however assiduous, for acquiring intellectual treasures in the exercise of our mental powers, can be so successful or satisfactory as where men unite together to grapple with ignorance, and mutually to instruct each other. The formation of societies for this purpose cannot be too strongly recommended. An account of such an institution formed in Glasgow for the improvement of a single body of workmen will strongly illustrate these remarks.

The Gas Light Chartered Company of that city constantly employs between sixty and seventy men in the works; twelve of these are mechanics, and the others furnace-men and common laborers of different descriptions. In 1821 the manager of the works proposed to these men to contribute each a small sum monthly, to be laid out in books to form a library for their common use. He informed them that if they agreed to this, the Company would give them a room to keep the books in, which should be heated and lighted for them in winter; that in this room they might meet every evening throughout the whole year to read and converse, in place of going to the alehouse, as many of them had been in the practice of doing; that the Company would further give them a present of five guineas to expend on books; and that the management of every thing connected with the measure should be intrusted to a committee of themselves, to be named and renewed by them at fixed periods. Fourteen of the workmen were induced to agree to the plan. A commencement was thus made. For the first two years, until it could be ascertained that the members would take care of the books, it was agreed that they should not remove them from the reading room, but that they should meet there every evening to peruse them. After this period, however, the members were allowed to take the books home; and they then met only twice a week at the reading room, to change them, and converse upon what they had been reading. The increase of the number of subscribers to the library was at first very slow, and at the end of the second year the whole did not amount to thirty, but from conversing twice a week with one another at the library, upon the acquisitions they had been making, a taste for science and a desire for information began to spread among them. They had, a little before this time, obtained an Atlas, which, they say, led them to think of a pair of Globes. One of their members, by trade a joiner, who had had the advantage of attending two courses of lectures in the Andersonian Institution, volunteered, on the third year after the formation of the society, to explain to its members the use of the Globes. This he did one evening in every week, and succeeded so well that he offered, on the other meeting in the week, to give an account of some of the principles and processes in mechanics and chemistry, accompanied with a few experiments. He next, and while he was still going on with his lectures,

undertook, along with another of the workmen, to attend in the reading-room during the other evenings in the week, and teach arithmetic to such of the members as chose. The society now made very rapid progress, and its members were induced to make a new arrangement, by which the labor of instructing was more equally divided.

The individuals of the committee agreed among themselves to give in rotation a lecture either on chemistry or mechanics every Thursday evening, taking Murray for their text-book in the one, and Fergusson in the other. The plan is still pursued. It is intimated a fortnight before to the person whose turn it is, that he is to lecture from such a page to such a page of one of these authors. He has, in consequence, these fourteen days to make himself acquainted with the subject; and he is authorized to claim, during that period, the assistance of every member of the society in preparing the chemical experiments, or making the little models of machines for illustrating his discourse.

It is a remarkable circumstance in this unique process of instruction, that there has been no backwardness found on the part of any of the individuals to undertake to lecture in his turn, nor the slightest diffidence exhibited in the execution. This is attributed solely to its being set about without pretension or affectation of knowledge, and merely as a means of mutual improvement.

On the Monday evenings the society has a voluntary lecture from any one of its members who chooses to give notice of his intention, on either of the branches of science already mentioned, or upon any other useful subject he may propose. And there is with the general body the same simple unhesitating frankness, and disposition to come forward in their turn, that exist among the members of the committee with regard to the lectures prescribed to them. It may be interesting as well as useful to mention some of the subjects of the different lectures that were given during the first three months after this plan was adopted. Those delivered by the members of the committee consisted of eleven on mechanics, including the application of the mechanical powers; one on magnetism and electricity; one on wheel carriages; one on the primitive form of crystals; and one on hydrostatics. The voluntary lectures treated on the air pump, chemistry, &c., besides many practical subjects, such as boring and mining; Sir Humphrey Davy's lamp; the construction of a corn mill; and a description of Captain Manby's invention for the of shipwrecked seamen.

The effect of this society was soon found to be most beneficial to the general character and happiness of the individuals composing it. It may readily be conceived what a valuable part of the community the whole of our manufacturing operatives might become, if the people employed in every large work were enabled to adopt similar measures. What might we not then be entitled to look for, in useful inventions and discoveries, from minds awakened and invigorated by the self-discipline which such a mode of instruction requires.

The Gas Company being fully aware of the beneficial consequences resulting from the instruction of their work-people, fitted up for their use, in the latter end of 1824, a more commodious room for their meetings, with a small laboratory and workshop attached to it, where the experiments are conducted, and the models to be used in the lectures are prepared. Previously to this time the men had made for themselves an air-pump and an electrifying machine, and some of them are constantly engaged in the laboratory and workshop during their spare hours. At the end of three years from its commencement, the whole of the workmen, with the exception of about fifteen, became members of the society, and these were withheld from joining in consequence of their inability to read. The others said to them, "Join us, and we will teach you to read." It is gratifying to know that this invitation has not been made in vain; and that at the present time this association, now amounting to upwards of seventy persons, comprehends nearly all those employed about the works.

The rules of the society, which have been framed by the members themselves, are simple and judicious. Every person on becoming a member pays seven shillings and sixpence of entrance money. This sum is taken from him by instalments, and is paid back to him should he leave the gas works, or to his family or heirs should he die. Besides this entrance money, each member contributes three halfpence weekly; two-thirds of which go to the library, and one-third to the use of the laboratory and workshop. The weekly lectures are continued during the winter months, and the members are permitted to bring to these any of their sons who are above seven and under twenty-one years of age. Additions have from time to time been made to the chemical and mecha-

nical apparatus, and the library now contains seven hundred volumes.

Economy.—"A slight knowledge of human nature will show," says Mr. Colquhoun, "that when a man gets on a little in the world he is desirous of getting on a little further." Such is the growth of provident habits that it has been said, if a journeyman lays by the first five shillings his fortune is made. Mr. William Hall, who has bestowed great attention on the state of the laboring poor, declares he never knew an instance of one who had saved money coming to the parish. And he adds, moreover, "those individuals who save money are better workmen: if they do not the work better, they behave better and are more respectable; and I would sooner have in my trade a hundred men who save money, than two hundred who would spend every shilling they get. In proportion as individuals save a little money their morals are much better; they husband that little, and there is a superior tone given to their morals, and they behave better for knowing they have a little stake in society." It is scarcely necessary to remark, that habits of thoughtfulness and frugality are *at all times* of immense importance.—[Wilderspin's Early Discipline.]

Saturday Night's Wages.—The system frequently pursued in manufacturing towns in paying the wages of Mechanics, is not, perhaps, calculated to give to these all the advantages which they should derive from their hard earnings.

It is the custom in many factories to pay the wages of the week at a neighboring public house on the Saturday evening, after the labors of the day are over. This duty, in a large establishment, is a work which necessarily occupies some time; and the most sober and well-disposed, those most anxious to take their earnings home to their families, cannot obtain their money in time for procuring the Sunday's meal before the usual hour of rest. After a hard day's labor, spent in domestic cares, and in rendering the dwelling in a fit state for the coming day, the weary housewife would gladly seek repose. Under this arrangement, however, she is obliged to encroach on the period which should be devoted to sleep, in order to make her requisite purchases, or to invade the quiet of the Sabbath morning with the petty cares of life, which, for that one day at least, should be laid aside.

This in itself is a great annoyance to the female part of the community; but it is light as air to them, compared with the more serious evil which the system carries in its train, and which they would gladly exchange for any personal inconvenience they might be called upon to endure.

Workmen of the most abstemious habits consider themselves in a manner constrained to take some refreshment in the house where they have just received money; and though they may spend but a trifle, that trifle would have been better bestowed in assisting to minister to the wants of those nearest and dearest to them. But what a temptation is held out to men of a less temperate character. Here the love of noisy fellowship is nourished, unfitting the mind for the quiet enjoyments of home. Here the habit of intoxication is gradually acquired and confirmed. While wives are anxiously waiting at the door of the house for those supplies which will enable them to furnish necessaries for their families, husbands are too often rioting within, forgetful of those ties which should prevent such a waste of time and money in selfish and degrading enjoyment; and when, at length, the expecting female does obtain the residue of the earnings which should have been appropriated to the support of her family for the ensuing week, she finds the sum fearfully diminished and inadequate for the purpose.

Many a watchful mother has had to mourn over the ruined prospects of a beloved son, whose first deviation from right was the loitering at the public house on the Saturday night; his former simple habits gradually turned into those of selfishness, and all its lamentable consequences. Many an affectionate wife has had to grieve at this wreck of her early happiness, first invaded by the Saturday night's temptation; while she is either left to struggle neglected and alone through the miseries of life, or called upon to endure more active ill-treatment from her inebriated partner.

It may be said we are rather exaggerating the picture; that a large proportion of those who gain their livelihood by working as mechanics are respectable, intelligent, and virtuous members of society. Most happily this is true; but we think a still farther number might be ranked in the same class, if the payment of wages were better regulated, while the comfort of the artisans, and that of their families, would at the same time be materially increased.

There can be little doubt that, were proprietors once convinced of the bad effects which arise from this plan, they would adopt one more conducive to the comfort of those by whose labor they are benefitted. A walk in a manufacturing town at twelve o'clock on the Saturday night would sufficiently expose the evils of this manner of payment. The shops are then still open, and harrassed females are seen flocking to them; the streets are crowded with people; and many women, with looks of distress, are still lingering at the doors of the pay-houses, in the vain hope of alluring home their truant husbands. The whole continues a scene of noise, bustle and confusion, long past the hour of midnight, and but ill-befitted to usher in the day of rest. How unlike the holy soothing repose of the Cotter's Saturday Eve, so beautifully described by Burns.

If payment of the week's earnings were made on the respective premises, instead of at a drinking-house, and on the Friday instead of the Saturday evening, all these evils might at once be avoided.

The men would have no temptation given them to spend their earnings away from their families—the women would be enabled to make their purchases on the Saturday, at the time most convenient for the purpose, and they would have one chance less for unhappiness.

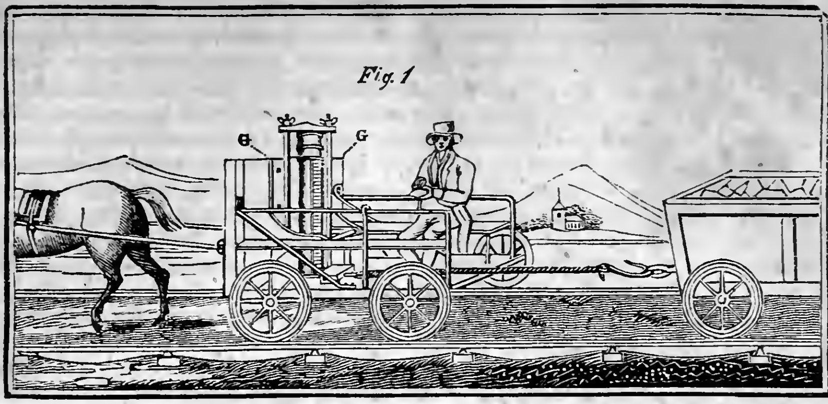
Two objections are made to this proposed alteration—the one moral, the other practical.

It is said that, with a well furnished pocket, a man not very industrious may be inclined to indulge himself in idleness during the ensuing day; but this would evince so total an absence of foresight and prudence, that the individual capable of such conduct would, we fear, when paid on the Saturday, in like manner take his holiday on the Monday, or just as long as his money might last.

The other objection arises from the mode in which the wages are usually paid at a large establishment. The required amount of money is in the first instance deposited in the hands of the confidential foreman, who does not pay each individual workman, but divides the whole in classes, and to a responsible man in each of these intrusts the sum due to his particular class: should the individuals of which this is composed be very numerous, he in his turn subdivides it, till at length the various claimants receive their due. The transaction is not, therefore, simply that of a proprietor paying his men, but it involves itself into a much more complicated form, and the men must necessarily have a common place of rendezvous to adjust their various accounts. That this difficulty may be obviated, and that it is in fact nearly as easy to pay on the premises as to adjourn to another house, we happen to be furnished with a practical proof. The proprietor of a large concern, not residing on the spot where it is carried on, had recently occasion to proceed to that place in order to examine more particularly how the works were conducted. He immediately perceived the bad effects arising from the system of paying the workmen at a drinking-house, and determined at once to abolish the practice. This intention was strongly combatted by the superintendant, who assured him that it was an impossibility to pay all the men at the works, for if the few to whom he delivered the money for their respective divisions were to receive it on the premises, they would of their own accord repair to the usual pay-house with those to whom the money was due, in order to make a settlement among themselves.

The gentleman persevered, however, in his intention; and on the day of payment, he himself, without any assistance, paid into the hands of each workman before he left the premises the wages due to him. He thus proved the practicability of the alteration, and acquired the right of insisting that henceforth the plan should always be pursued. By a little method, and by the aid of a few assistants, this work would of course be comparatively easy to one understanding its practical details; if in the absence of these advantages it was accomplished without any difficulty, in the manner we have described, by one quite new to the business, in an establishment where numerous workpeople are employed, it follows that this objection is of no weight.

To ascertain the height of a steeple, tower, &c.—Take two sticks of any but equal length, and holding one perpendicular, place one end of the other against its centre, so as to form a right angle with it; having done this, place your eye at the other end, and advance towards, or recede from, the object the height of which you wish to ascertain, until the upper and lower ends of the perpendicular stick shall appear to touch its top and bottom at the same time; then, from the spot on which you stand, measure the distance to the foot of the object, and this will be its exact height.



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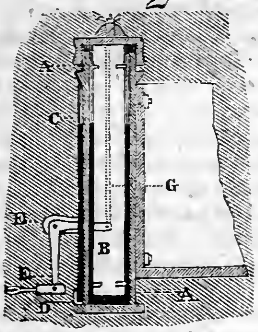

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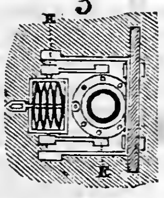

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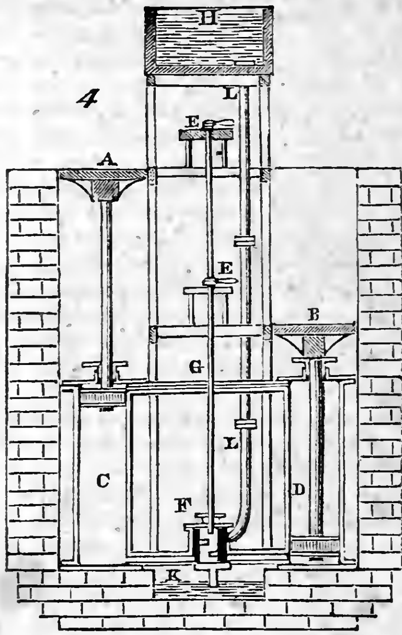


Milne's Mercurial Dynamometer, and Railway Lock for raising Carriages from one Level to another. [From the London Mechanics' Magazine.]

In our review of Mr. Milne's excellent "Practical View of the Steam Engine," we made mention of a mercurial dynamometer, for which Mr. M. had received the honorary gold medal of the Highland Society of Scotland. We now proceed to fulfil our promise of extracting from Mr. M.'s "Appendix" the following descriptive particulars of this instrument; and shall subjoin thereto an account of an ingenious apparatus which Mr. M. has also devised for raising or lowering railway carriages from one level to another.

The Dynamometer.—Practical engineers complain that those dynamometers which indicate the quantum of force applied by a horse upon a railway, by the inflection of springs, lose their elasticity when kept at work for a considerable time; the oscillations of the index-pointer, too, make it impossible to ascertain the medium of unequal draught applied by the animal in stepping out. Such also is the case when any other common instrument is used for this purpose. Both of these defects are completely obviated by the mercurial dynamometer now to be described. This instrument consists of a hollow metallic cylinder, A, fig. 2, in which is placed a floating piston, B, which should be about one-

tenth of an inch less in diameter than the cylinder in which it must move freely up or down. To prevent friction, four small rollers should be inserted into the side of this wooden float, both at its top and bottom; which rollers should not project further than to admit of the piston being "shake-free" within its cylinder. In order, also, to prevent absorption of the mercury, the wood should be coated with bees' wax mixed with whitening or with lamp-black. These things being attended to, and a portion of mercury placed within the cylinder, by pushing down the piston the fluid will ascend in a thin film between it and the cylinder, till the statical weight of the mercury, acting on the base of the floating piston, balances the force exerted in pushing it down. Hence, since the statical weight of the fluid increases reciprocally as the height to which it is caused to ascend by its displacing force, so must its various points of height within the cylinder be a measure of the force in equilibrio with the statical weight of the fluid.

Such being the construction of this dynamometer, it is only necessary to fix it in a vertical position to the front of the foremost of a train of waggons, and to turn the direction of the horses' draught in such a manner as to cause it to pull down the floating piston; while a glass tube exhibits the height of the fluid, and consequently the force exerted by the animal. To prevent any sudden elevations or depressions in the mercury in the tube, from the irregularity of the horses' draught, the socket in which it is placed has a ventricle at D, the diameter of which is .033 of an inch, while that of the glass tube is .250; wherefore $\frac{.250^2}{.033^2} = 57{\cdot}4$; hence the elevation or depression of the mercury in the tube must be 57·4 times less than in the cylinder; the celerity of which fluid, too, is still further reduced by springs attached to the draught-hook, as seen in the plan, fig. 3. Since this machine was first constructed, it has occurred to Mr. Milne that, by attaching a stop-cock, the celerity of the motion of the mercury in the glass tube could be regulated to any required extent with the utmost exactness. In addition to these contrivances, oscillations of the fluid might be still further prevented by making the yoke-levers, E, shorter than those which pull down the piston. The friction of the arbor, F, might also be much lessened, by making its extremities similar to the bearing-pivots of a common balance.

Mr. Granger, the engineer, having placed this dynamometer on a carriage (represented in fig. 1) so constructed that neither the weight of the instrument nor of the persons upon it should affect the results, made a number of very interesting and useful experiments with it on the Kirkintilloch Railway. The first object in these experiments was to ascertain the capabilities of the dynamometer; on which head nothing can be more satisfactory than the testimony Mr. G. has given. "It is altogether superior," he says, "to any other I have seen; and it is the opinion of several engineers, who have seen it at work, that it is the best instrument for engineering purposes that has ever been tried." A long and circumstantial narrative of these experiments is given, but it is only necessary that we should here place before our readers the principal facts which they have established with respect to friction on railways:

1. The medium friction of a train of five waggons on a level part of the railway was 9 lbs. per ton; while on a curved part, with a radius of about 800 feet, it was 18 lbs. per ton.

2. A draught of 10·8 lbs. per ton was required to travel at the rate of three miles an hour when the rails were dry, and only 6·8 lbs. when wet.

3. On a level the force exerted by horse was observed to vary from 90 to 110 lbs., but when the train came to a part of the railway which inclined at the rate of 1 in 280, the waggons descended freely by their own gravity.

4. On a descent of 1 in 117, a waggon with wheels 2·5 feet in diameter carried 1020 lbs. more weight than one with 3 feet wheels, at the same rate of speed and with the same power applied: but on a curve with a radius of a thousand feet, the 3 feet wheels proved superior to the 2·5—a circumstance which Mr. Milne ascribes to the axles of the 3 feet wheels being of two pieces, meeting within a bush at the centre, while the 2·5 wheels were attached by an inflexible axle, whence it followed, in the case of the former, that "all the wheels would roll upon the rails of different radii, independent of the motions of each other."

5. The average force of draught required on a level at 3·5 miles per hour was 8 lbs. per ton; at 6·66 miles, 9·5 lbs.; at 7·5 miles, 10·2 lbs.; at 8 miles, 10·67 lbs.; at 8·57 miles, 11·63 lbs.

The Railway Lock.—Let A and B, fig. 4, be two platforms, on which the waggons

are to be elevated or let down; A being at the upper level and B at the lower. C and D are two cast iron cylinders filled with water, and having water-tight pistons supporting the platforms, A and B. Suppose, now, that a train of waggons has been placed on the platform, B, to be raised to the upper level, and that a greater weight is about to descend upon A; then by turning the handle, E, of the fourway-valve, F, to a proper point on an index beneath it, the superior weight on A will press the water below its piston through the valve F into D, and thereby elevate the weight upon B; the fluid above the piston in D passing over into C by the pipe G. But suppose there is no counter-weight ready to descend on A when it is required to raise a load on B, then by turning the handle E, the water in the cistern H will descend and press upon the piston D, while simultaneously the water above D will pass off through the pipe G into C, and the water below the piston in C will make its exit through one of the water-ways of the valve F. Or if, on the other hand, there should be a load descending on A when there is none ascending on B, the valve F has only to be turned in proportion to the load (a matter which practice would easily determine), when a corresponding weight of water will be driven from the cylinders up the pipe and into the cistern H; in which case the cylinders below the ascending platform will fill themselves from the well K. The power of a machine of this kind may be stated as being equal to the weight of a column of water whose base is equal to the height of the fluid in the pipe L; and were this pipe a transparent tube, with a graduated scale attached to it, the height of the fluid in the tube would clearly point out the quantity of weight incumbent on one or other of the platforms, *minus* the friction of the pistons.

General Education.—A strange idea is entertained by many that education unfits persons for labor, and renders them dissatisfied with their condition in life. But what would be said were any of the powers of the body to be in a certain case disused? Suppose a man were to place a bandage over his right eye—to tie up one of his hands—or to attach a ponderous weight to his legs—and, when asked the cause, were to reply, that the glance of that eye might make him covetous—that his hand might pick his neighbor's pocket—or that his feet might carry him into evil company—might it not be fairly replied, that his members were given to use, and not to abuse, that their abuse is no argument against their use, and that this suspension of their action was just as contrary to the wise and benevolent purpose of their Creator as their wrong and guilty application? And does this reasoning fail when applied to the mind? Is not the unemployed mental faculty as opposed to the advantage of the individual as the unused physical power? Can the difference between mind and matter overturn the ordinary principles of reasoning and of morals? Besides, how is man to be prepared for the duties he has to discharge? By mere attention to his body? Impossible. The mind must be enlightened and disciplined; and if this be neglected, the man rises but little in character above the beasts that perish, and is wholly unprepared for that state to which he ought to have aspired.—[Wilderspin's Early Discipline.]

Thus I Think. [From Locke's Miscellaneous Papers, published in his Life by Lord King.]

It is a man's proper business to seek happiness and avoid misery. Happiness consists in what delights and contents the mind; misery in what disturbs, discomposes, or torments it.

I will therefore make it my business to seek satisfaction and delight, and avoid uneasiness and disquiet; to have as much of the one and as little of the other as may be.

But here I must have a care I mistake not; for if I prefer a *short* pleasure to a *lasting* one, it is plain I cross my own happiness.

Let me then see wherein consists the most lasting pleasure of this life, and that, as far as I can observe, is in these things:

1st. Health,—without which no sensual (as opposed to intellectual) pleasure can have any relish.

2d. Reputation,—for *that* I find every body is pleased with, and the want of it is a constant torment.

3d. Knowledge,—for the little knowledge I have, I find I would not sell at any rate, nor part with for any other pleasure.

4th. Doing good,—for I find the well-cooked meat I eat to-day does now no more delight me, nay, I am diseased after a full meal; the perfumes I smelt yesterday now no more affect me with any pleasure; but the *good turn* I did yesterday, a year, seven years since, continues *still* to please and delight me as often as I reflect on it.

5th. The expectation of eternal and in-

comprehensible happiness in another world is that also which carries a constant pleasure with it.

If, then, I will faithfully pursue that happiness I propose to myself, whatever pleasure offers itself to me, I must carefully look that it cross not any of those five great and constant pleasures above mentioned. For example, the fruit I see tempts me with the taste of it that I love; but if it endanger my health, I part with a constant and lasting for a very short and transient pleasure, and so foolishly make myself unhappy, and am not true to my own interest.

Innocent diversions delight me: if I make use of them to refresh myself after study and business, they preserve my health, restore the vigor of my mind, and increase my pleasure; but if I spend all or the greater part of my time in them, they hinder my improvement in knowledge and useful arts, they blast my credit, and give me up to the uneasy state of shame, ignorance, and contempt, in which I cannot but be very unhappy. Drinking, gaming, and vicious delights will do me this mischief, not only by wasting my time, but by a positive injury endanger my health, impair my parts, imprint ill habits, lessen my esteem, and leave a constant lasting torment on my conscience; therefore, all vicious and unlawful pleasures I will always avoid, because such a mastery of my passions will afford me a constant pleasure greater than any such enjoyments, and also deliver me from the certain evil of several kinds, that by indulging myself in a present temptation I shall certainly afterwards suffer.

All innocent diversions and delights, as far as they will contribute to my health, and consist with my improvement, condition, and my other more solid pleasures of knowledge and reputation, I will enjoy, but no farther; and this I will carefully watch and examine, that I may not be deceived by the flattery of a present pleasure to lose a greater.

The Printing Press in Turkey.—Mr. Mountstuart Elphinstone, in his very interesting Account of the Kingdom of Caubul, (a country near the higher waters of the Indus, between India and Persia,) and of the scattered Afghan tribes dependant thereon, gives the following anecdote of the Naikpeekhail, who, like the rest, profess the Mahometan religion, but are so barbarous that even reading is looked down on as an unmanly accomplishment among them.

"Some men of the Naikpeekhail found a Mollah, or doctor of the Mahometan faith, copying the Khoran, or their Bible, and not well understanding the case, they struck his head off, saying 'You tell us these books come from God, and here are you making them yourself.'"

The Turks are not quite so ignorant as this, but even they, not many years ago, when Sultan Selim introduced the art of printing, were led to believe that it was sinful to print the Khoran—that nothing but the pen and hand-writing could, without impiety, multiply the copies of their Scriptures.—Other works might go through the press, but unfortunately, at the time, the Turks read no book except the Khoran, and so the inestimable benefit of printing was to be thrown away upon them! This absurd prejudice originated in, or was kept alive by, the Turkish copyists, who gained a livelihood by transcribing the Khoran, each copy of which cost the people a hundred times as much as the copy the press could have afforded, and the printed copy, besides, would have been infinitely the more distinct and legible of the two.

The present Sultan, among his many reforms and improvements, has succeeded to set the press to work in earnest. Many elementary works have been printed, some three or four of a higher character, on History and general Geography, and now a newspaper (that novelty for the Turks!) comes regularly from the Sultan's printing offices, and is circulated through the vast empire. We are informed by a friend, who writes from Constantinople, that it is a very interesting sight to see the effects that have already sprung from these salutary measures. Instead of every coffee-house being crowded as it used to be, by idle, silent, stupified loungers, doing nothing but smoking their pipes, you find them now (in less numbers indeed, which is also a good thing,) occupied by men attentively reading the newspaper, or conning over "the last new work" neatly printed, and sold at a very cheap price. Before this, and almost up to last year, they were in the condition that all Europe was in four hundred years ago, or previously to the invention of printing, when only the comparatively rich could afford to buy a book or any thing to read. Even on the quays of the port, and in the bazaars of Constantinople, you now see Turks occupying their leisure moments with the productions of the press, which is thus becoming day by day more and more active.

We extract from the April number of the "London Repertory of Inventions," specifications of two patents recently obtained there, which we think will be useful to those who are concerned in constructing railways in this country, as well as iron founders, and in fact, to all who are in any way interested in the progress of internal improvements. If they are important (and we think they are), it will be a matter of gratification to us to elicit from some of our numerous subscribers their opinion as to the utility of them. From directors, and others engaged in constructing railways, we especially invite communications—no matter what view of the matter they take, our columns are open for their opinions, confident that by discussion the real value of the invention will be arrived at. We hope that our esteemed correspondents, Messrs. Bulkley and Sullivan, may here find something upon which they may "tilt the lance" once more.

Patent granted to Daniel and George Horton, Iron Masters, Leys Iron Works, Stafford co. England, for an improved Puddling Furnace, for the better production of manufactured iron, in the process of obtaining it from the pig.

These gentlemen have found that pig iron, having undergone the action of the refining furnace, requires a degree of heat for its refusion, in the process of puddling, so great that the materials of which this latter furnace is composed are very speedily destroyed or rendered useless. They conceive that the refining furnace may be altogether dispensed with; and they suggest a process whereby the puddling may be conducted on a more economical and efficient plan.

Their improvement is extremely simple in its principle. It is the excessive heat which destroys the furnace; therefore, their object is to disperse and carry off as much as possible of this heat from the furnace, without in the least lowering the temperature to which the iron must be submitted in the operation of puddling. Where it is possible to expose the whole external surface of the puddling furnace to the action of the atmosphere, its sides may be composed of plates of iron, fitly prepared, and the stream of atmospheric air will carry off a sufficient quantity of the heat to prevent the consumption of the material of the furnace.

Wherever such exposure is impossible, the patentees would surround their furnace with a series of pipes, so constructed as to serve as bridges for the furnace; and these pipes should be made to circulate rapidly a strong force of water, perpetually supplied, and regularly carried off as it becomes heated. Of course, other means might be suggested; any good conductor of heat may be applied to the surface of the furnace, and the superfluous caloric may be carried off by radiation or otherwise.

They commence their process by throwing on to the bars of the furnace a quantity of the slag, ore, or scoria of the smelting furnace, and when that is in a state of fusion they throw in the pig iron, without its having undergone the usual operation of refining. When it is melted, the heat is increased until the iron boils; and the puddler works it until the slag or earthy matter is all carried away, and the iron remains pure: it is then ready for the forge hammers, or other proofs of its malleability. The patentees claim as their invention, only, the carrying off some portion of the heat from the exterior of the furnace itself, and that by means of atmospheric exposure, or aqueductory pipes.

Patent granted to Geo. Jones & Co., of Wolverhampton, Stafford co., England, for an improvement in making malleable iron.

This patent carries much further the simplifying process than that granted to the Messrs. Hortons. The practical men who have united in securing its advantages to themselves, have seen, like Messrs. Hortons, the uselessness of the refining furnace, but they purpose to carry the metal, in its first fusion, at once from the smelting furnace to the puddling furnace. They have no pigs at all: pig iron is a waste of time and material.

There is no occasion, they say, to use fuel to heat over again the iron after it has cooled in the form of pigs. They would have it retain the heat of the smelting furnace, and thence they would carry it by hand, in ladles, or in pails, or by any other utensil adapted to the purpose, at once to the puddling furnace.

If the accidents of place would permit, they could, of course, prefer the obvious plan of carrying the smelted metal by a pipe, or channel, or drain, from the one furnace to the other, and this they would claim as a part of their invention. Now, it so happens, that this system has, to our certain knowledge, been acted on for upwards of twenty years, and that in more places than one. However, *publication alone* insures private right. It is remarkable that two patents

should have been granted on succeeding days for purposes acting so exactly on each other; their combination would be a yet greater improvement. In both cases the refining is dispensed with. If portability be no object, and local circumstances are favorable, these plans will effect a great saving of time and money.

To render Leather, Linen, &c. water-proof.—Take 100 lbs. of the best linseed oil; add one and a half pounds of acetate of lead, one and a quarter pounds of calcined amber, one and a half pounds of white lead, and one and a half pounds of very finely powdered pumice-stone. These solid substances, well ground and mixed together, must be boiled in the oil for ten hours, over a moderate fire, to prevent the oil from burning. This varnish should be of such a consistence, that, when mixed with a third part of its weight of pipe clay, it will be as thick as treacle. It is left to settle eight days, and is then passed through a lawn sieve. The next process is to grind, in a solution of strong and clear glue, as much pipe clay as amounts in weight to the tenth part of the oil employed, and to mix it to the consistence of ointment; adding the varnish by degrees, and stirring it well with a wooden spatula or stick. This varnish must be repeatedly stirred, till it becomes perfectly fluid; and then the desired tint is given by adding a fourth part of the color, ground in oil.

The linen must be stretched upon a wooden frame; and the composition applied upon it with a large spatula, three inches broad and nine inches long. The frame is then inverted, and the operation repeated upon the other side of the cloth: it is then left to dry for a week, and separated from the frame for use.

This cloth may be used for covers for carriages, &c.

For leather and skins, the same composition is used; but to give to the surface a smooth and brilliant appearance, the following varnish is employed. Take five pounds of the oil varnish, and an equal weight of well clarified resin; boil them together until the resin is dissolved; then add two pounds of oil of turpentine, having the color to be given to the varnish ground with it, and passed through a lawn sieve. This varnish is to be applied with a brush. When the varnish is thoroughly dry, it must be rubbed even with a pumice stone and water, and then washed clean. Two or three coats of varnish being then applied, and each coat suffered to dry for two or three days, is sufficient to produce a brilliancy equal to that of the Japan lacker.—[Bulletin de l'Industrie.]

Water in the Desert.—Among those improvements of the age which afford pleasing topics of contemplation is the following, taken from the Boston Transcript: Two persons who understood the business of boring for water, were lately taken to Egypt, by Mr. Briggs, then consul at Cairo. They were employed, under patronage of the Pacha, to bore for water in the Desert. "At about thirty feet from the surface (says the Repertory of Patent Inventions) they found a stratum of sand stone; when they got through that, an abundant supply of water was procured. We believe the experiment has succeeded at every place where it has been made. The water is soft and pure." In the Desert of Suez a tank has been made, of 2,000 cubic feet contents, and several others are in building.

It is a question worthy of philosophical consideration, what may be the effect of this discovery on the civilization of Egypt and Arabia—the fertilization of the soil—the increase of population—and the advantages derived by that commerce to which the barren and arid deserts have presented so many obstacles.

A companion that is cheerful, and free from swearing and scurrilous discourse, is worth gold. I love such mirth as does not make friends ashamed to look upon one another next morning; nor men, that cannot well bear it, to repent the money they spend when they be warmed with drink. And take this for a rule: you may pick out such times and such companions, that you may make yourselves merrier for a little than a great deal of money; for "'tis the company and not the charge that makes the feast."—[Izaak Walton.]

Imitation of Nature.—When Smeaton rebuilt the Eddystone lighthouse, he took much time in considering the best method of grafting his work securely on the solid rock, and giving it the form best suited to secure stability: and one of the most interesting parts of his interesting account is that in which he narrates how he was led to choose the shape which he adopted, by considering the means employed by Nature to produce stability in her works. The building is modelled on the trunk of an oak, which spreads out in a sweeping curve near the roots, so as

to give breadth and strength to its base, and again swells out as it approaches to the bushy head, to give room to the strong insertions of the principal boughs. The latter is represented by a curved cornice, the effect of which is to throw off the heavy seas, which being suddenly checked fly up, it is said, from 50 to 500 feet above the top of the building, and thus to prevent their striking the lantern even when they seem entirely to enclose it. The efficacy of this construction is such, that after a storm and spring-tide, of unequalled violence, in 1762, in which the greatest fears were entertained at Plymouth for the safety of the lighthouse, the only article requisite to repair it was a pot of putty, to replace some that had been washed from the lantern.—[Gallery of Portraits, with Memoirs.]

Dr. Franklin's Moral Code.—The great American philosopher and statesman, Benjamin Franklin, drew up the following list of moral virtues, to which he paid constant and earnest attention, and thereby made himself a better and a happier man :—

Temperance.—Eat not to fulness ; drink not to elevation.

Silence.—Speak not but what may benefit others or yourself; avoid trifling conversation.

Order.—Let all your things have their places ; let each part of your business have its time.

Resolution.—Resolve to perform what you ought ; perform without fail what you resolve.

Frugality.—Make no expense, but do good to others or yourself; that is, waste nothing.

Industry.—Lose no time ; be always employed in something useful ; cut off all unnecessary actions.

Sincerity.—Use no hurtful deceit ; think innocently and justly ; and if you speak, speak accordingly.

Justice.—Wrong none by doing injuries, or omitting the benefits that are your duty.

Moderation.—Avoid extremes ; forbear resenting injuries.

Cleanliness.—Suffer no uncleanliness in body, clothes, or habitation.

Tranquility.—Be not disturbed about trifles, or at accidents common or unavoidable.

Humility.—Imitate Jesus Christ.

The same great man likewise drew up the following plan for the regular employment of his time; examining himself each morning and evening as to what he had to do, what he had done, or left undone ; by which practice he was better able to improve his future conduct :—

Morning.	*Hours.*	
The question, What good shall I do to-day?	6, 7, 8	Rise, wash, and address Almighty God! contrive the day's business, and take the resolution of the day; prosecute the present study ; and breakfast.
	9, 10, 11, 12	Work.
	1, 2	Read and look over my accounts, and dine.
	3, 4, 5, 6, 7	Work.
Evening.	*Hours.*	
The question, What good have I done to-day? what have I left undone which I ought to have done?	8, 9, 10	Put things in their places; amusement; supper ; examination of the day ; address the Almighty.
	11, 12, 1, 2, 3, 4, 5	Sleep.

A steady perseverance in *some plan* for the arrangement of our time, adapted to circumstances, cannot fail improving our general conduct in life, and rendering us better members of society, and better Christians.

When we read the lives of distinguished men in any department, we find them almost always celebrated for the amount of labor they could perform. Demosthenes, Julius Cæsar, Henry the Fourth of France, Lord Bacon, Sir Isaac Newton, Franklin, Washington, Napoleon,—different as they were in their intellectual and moral qualities, were all renowned as hard workers. We read how many days they could support the fatigues of a march ; how early they rose ; how late they watched ; how many hours they spent in the field, in the cabinet, in the court ; how many secretaries they kept employed ; in short, how hard they worked.—[Everett's Discourse.]

Amount of Power lost by Curves on Railways. By S. D. To the Editor of the American Railroad Journal.

Sir,—A very curious and very necessary table remains still a desideratum in the science of railways, which I am inclined to believe the observations of experienced engineers would be able to furnish us with—I mean of the amounts of power lost by curves on railways. This loss, for the sake of a ready perception of its value, I would oppose to a relative inclination in this manner, which would, I imagine, bear to fully elucidate a very important section of that branch of engineering:

A curve of 5,000 feet radius is equal to a rise of, say		1 in 200
" 1,000	"	1 in 150
" 600	"	1 in 100
" 200	"	1 in 50, &c.

&c., always supposing the outer rail of the curve as in practice to be raised above the level of the inner rail.

I know that some experiments have been made with this view, but I have never met with an account of them, and, in common with many others, am anxious to learn the results of such experiments. It appears to me to be one of those chapters on railways least understood at present, and on which the greatest improvements remain yet to be effected. Very respectfully yours,

S. D.

Boston, May 12, 1833.

The subject referred to in the above communication we deem one of considerable importance, and shall be much obliged if some of our correspondents will furnish us with the desired information.—[Ed. R. J.]

Homer and Steam.—At the ninth anniversary of the London Mechanics' Institution, Dr. Birkbeck, in awarding a prize of £20 for the best essay on steam, observed, that the author had discovered several notices of the power of steam by the ancients, which had escaped preceding writers. He had also detected, in the eighth book of the *Odyssey*, a probable allusion to steam navigation:

"So shalt thou instant reach the realms assigned,
In wondrous ships, self-moved, instinct with mind:
No helm secures their course, no pilot guides;
Like man intelligent they plough the tides,
Conscious of every coast and every bay,
That lies beneath the sun's all-seeing ray.
Though clouds and darkness veil the encumbered sky,
Fearless through darkness and through clouds they fly,
High tempests rage, high rolls the swelling main,—
The sea may roll, the tempests rage in vain."

A Railway between Liverpool and London, we see by the English papers, is in contemplation, two bills being now before Parliament, which are represented as likely to receive the legislative sanction. The Liverpool Times remarks, that the joint work, to be undertaken by the managers of the Birmingham and Liverpool Line, when finished, "will be one of the noblest triumphs of science ever achieved, and one of the most important public benefits ever conferred by science on this country. In a few years Liverpool will probably be within twelve hours' ride of London. We shall be able to quit this place at six in the morning, and dine in the metropolis; or if night travelling should come into fashion, to ensconce ourselves snugly in the corner of a railway carriage in the evening, and awake next morning in Fleet street or the Strand. As for Birmingham, it will be a mere morning's ride either from London or Liverpool. This railway will also shorten the time of communication between the English and Irish capitals to twenty-four hours, so that London and Dublin will be as near for all practical purposes as London and Birmingham were fifty years ago, or as London and Liverpool are at present."

Improvements in Baking.—Some important improvements in the process of baking bread on a large scale have been recently put in operation in an English city. The same principles and similar apparatus, we believe, have already been applied to this purpose in our own country. We are induced to state that an individual of this place has invented an oven which, it is confidently believed, will far exceed the English invention, in reducing the labor of baking: one oven of this construction, we understand, will bake 24 barrels of flour every 24 hours—the entire time commonly occupied in heating and cleaning being saved, by keeping a constant fire *outside.* The same individual has now in operation a machine for forming the dough into biscuit, whereby a saving is secured of at least two-thirds of the labor required by the common method; and the flour intended for our shipping, we are told, may be baked into *thin* or *thick* bread, at a great reduction of expense. Cost of fitting a bakery according to the above plan, it is said, will not exceed $500. The inventor is desirous that the subject may be investigated by scientific and enterprising ship-owners and other citizens, trusting that his demonstrations will be such as to secure for his improvements an ade-

quate degree of encouragement.—[Nantucket Inquirer.]

Stone-Splitting Screws. By ROBERT MALLET. [From the London Mechanics' Magazine.]

SIR,—Some time since, while visiting the Bangor slate quarries, I was struck with the enormous waste of materials, arising from the mode adopted of shaking down large masses of slate to be afterwards split into roofing slates. The strata lie nearly vertical, and by every blast that is fired many tons of slate are shivered to atoms and made useless.

As a remedy for this, some powerful but simple application of the wedge appeared to me to be worthy of consideration. A conical male screw, working in a split female screw, placed in a jumper hole in the stone to be cleft, appeared one of the best that occurred; and, upon subsequent experiment, I find it to exceed my expectations, both for splitting, roofing, slate-work, and all other stones.

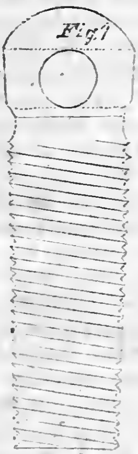
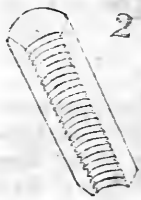


Fig. 1 represents a vertical screw for this purpose, made as an experimental one. It is about nine inches long in the screw, and two inches diameter at the lower end, and two inches and an eighth at the upper. It has a round thread, of as strong a form as possible, and a proper eye at top for the insertion of a lever. The two segments of a cylindrical shell, which form its nut or box, are each one-fourth the circumference of a complete cylinder, and half an inch in thickness; thus the jumper hole for this screw requires to be three inches diameter and nine inches deep.

The screw is made of iron, sheathed with steel like a tap, and hardened; and the box segments are made of cast iron, poured in an iron mould, which makes the screw threads very perfectly and cheaply; their brittleness and hardness are afterwards corrected by annealing. They alone are injured in the operation of splitting, and by this way of making them are easily replaced.

Now, I am fully aware of the objections that may be urged, of a conical screw being applied to a cylindrical one, and of the threads of a conical screw making variable angles with the axis; but the taper or angle of the cone requires to be but very small, being determined by the modulus of elasticity of the stone to be split, which in all rocks commonly met with is very low; so that the screw being very coarse—having round threads, being very little taper, and not requiring to fit accurately—those objections are not cogent.

Fig. 2 represents one of the segments of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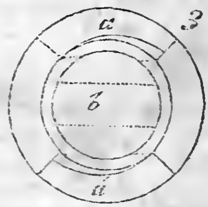

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the box or nut; and fig. 3 is an end view of the two (a a') in their places in the jumper hole; b, the screw.

To use this apparatus, the jumper hole being prepared, the two segments are placed at opposite sides of it, and the screw inserted and screwed down. The friction of the stone against the back of the segments keeps them in their respective places. The screw must descend, and as it descends it must expand the segments, and by their expansion the

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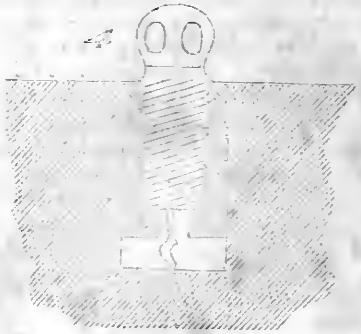

stone is split, (fig. 4.) I have found by experiment that the rock will always split in the direction of the interval between the seg-

ments, as in fig. 5; so that when a pro-

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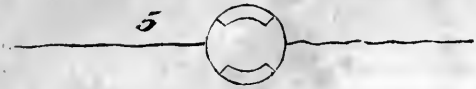

longed section of an homogeneous rock is required, it is easily produced by a number of such screws placed in the desired line, as in fig. 6. Omitting the consideration of the

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effects of friction, which, I am fully aware, are in this case very considerable, but can only be determined by experiments, it is sufficiently obvious that the power of this instrument is the same as that of a wedge employed for cleaving, whose angle is equal to that of the cone round which the screw is wrapped, urged, or driven on by the energy due to the same screw, actuated by a lever of a given length.

The power of this screw, then, is expressed by

$$P=\frac{h}{2\pi R}W.$$

where P is the power or energy of the screw; h, the distance between two contiguous threads; π, the constant ratio of the diameter of a circle to its circumference; R, the length of the lever used; and W, the power or dead weight applied.

The power of the wedge, again, is given by the equation,

$$P=\frac{R\,l\,B}{L^2}$$

P representing the energy with which the power of the screw acts against the resistance of the particles of the stone, the length from the point or extremity of the cleft or split when *first commenced*, to that point where the resistance may be supposed concentrated against the sides of the wedge, *i. e.* the screw segments; and L, the length of the cleft when first commenced. It is obvious, that R, l, and L, vary with different kinds of stone, and are constant with each particular kind; whence, for want of experimental data, it is impossible at present to reduce these equations to figures. The friction, too, of the instrument increases in a greater ratio than the pressure, from the continually increasing difference between the threads of the conical male screw and those of the cylindrical female screw.

So far, it will be admitted, I have not slurred over the difficulties and disadvantages to which the machine is exposed; but I have tried it, and the result of one experiment, at which the whole of the Commissioners of Public Works in this county, Mr. Vignoles, the engineer, of Liverpool, and Mr. John M'Mahon, of the firm of Henry Mullens & M'Mahon, were present, and expressed their entire satisfaction, will suffice.

Two men, with a lever of only *three feet in length*, and a single screw and segments of the size before described, split a mass of the argillaceous lime-stone of the county of Dublin, (*Calp* of Kirwan,) weighing nearly a ton, in 17 revolutions of the screw, made in about 25 or 30 sec. The men did not put forth their strength, but merely walked round the stone, which was split contrary to its stratification, and exactly in the line of separation of the segments. The sufficiency of the power is thus clearly shown.

Mr. John M'Mahon has informed me by note, that "he considers it a very great improvement in the art of quarrying."

This instrument is more particularly applicable to slate quarrying, and for the purpose of obtaining great tabular masses of granite, sienite, or other very hard and homogeneous rocks. In the former application, the saving of slate, and of labor in clearing the *face* of slate-rock of the accumulating rubbish shook down by the method of blasting, recommend it. In the latter, the saving of labor, the certainty of the direction of the fracture, and the capability of splitting larger blocks than have been as yet attempted by wedges. It may be also applied to raising stratified rocks from their beds, and as a substitute for blasting in general. The jumper holes usually used for the granite of this county are three inches in diameter, and sometimes *sixteen feet* deep. Each of these screws only requires a jumper hole of nine inches deep, and three inches diameter, and *no gunpowder*; and it is hardly questionable but that 20 of these screws, requiring *less* labor of preparation, would produce a greater effect than the one blast, besides producing it in a predetermined direction.

There is another advantage of these screws over blasting, that they are free from danger to the workmen employed in using them. There is but one way that I am aware of in which it is possible for them to fail, namely, by the threads of the screw splitting off; but the force required to strip a steel screw of one-fourth of an inch round thread, in depth and width, when twelve or fourteen threads are engaged at once, is enormous;

and when a number of screws are in action on one mass of rock, the force on any individual screw need not be great.

The first cost of such screws is not very great. The male or conical screws, being of hardened steel, will last a long time; and the segments are cheaply made, when once the mould is prepared, as they wear out or are broken. The cost of jumpers is less than for blasting purposes, as they are so much shorter. It is obvious, also, that these screws may be applied at the bottom of a fissure or jumper hole, as well as near the surface of the rock, by having the head of the screw properly prolonged.

Oil and black lead should be used to lubricate the screw during its descent. If a cast iron segment should break in the hole during the descent of the screw, it does not matter, as the pieces are still held by friction in their relative situations. The saving in gunpowder and labor alone, in such a place as the Bangor slate quarries, would pay the cost of some thousands of these screws, should they be found to succeed, in a few months I should suppose.

Mechanics in the country too generally do not avail themselves of the great advantages they would derive by cultivating a small spot of ground: where such is done, it adds greatly to their independence, and tends much to increase their domestic comfort. There are many who think it a matter of no importance so long as they can obtain all they wish at the stores, but do not take into consideration the great saving that would be effected by growing their own vegetables, and obtaining milk, butter and cheese, from the produce of their own cow. There are some who think it derogatory to their calling to do so: to them we would recommend a perusal of the following article, taken from the New-York Farmer.

Honorable Nature of Farming. By S. M.

To the Editor of the New-York Farmer.

Sir,—I have been much pleased with your sentiments on the dignity of the Farmer's calling, which you have frequently expressed in your columns, particularly in your editorial introduction, in the first number of the new series of the New-York Farmer. I have three sons, who are of the ages when young men begin to look forward into life, with a view of making choice of a profession. Mine are evidently inclined to almost any pursuit but that of farming, from an impression that it is not as honorable as many others. One wishes to be a doctor; another feels inclined to go to New-York, and become a clerk; and the third thinks the law alone is suitable to his ideas of that consequence and importance to which he hopes to arrive. Now, all this, Mr. Editor, is directly contrary to my wishes. I have a farm of upwards of 500 acres, and am desirous of dividing it into portions for my sons, as soon as they arrive at a suitable age. I could thus, under the ordinary blessings of Providence, make ample and sure provision for them—could have the pleasure in my declining years, of seeing my children comfortably situated, and pursuing a calling that naturally leads to many of those virtues and habits on which much of the happiness of life depends. With all my persuasion, I had not been able to give them any impression of the respectability of an agricultural vocation, until I, the other day, borrowed the numbers of the current volume of your Farmer. These numbers of your paper have accomplished more in the few days they have been in my house, than I have done by all my persuasion for years. I send you three dollars for the work, from the beginning of this year, and if it should be the means of causing my sons to look upon farming as one of the most useful and respectable pursuits in which intelligent and well educated youth can be engaged, I shall think you are entitled to half of my farm. Yours, &c. S. M.

Newark, N. J. May, 1833.

Remarks.—We hope S. M. will not forget us in his "last will and testament." We would be willing, however, to take up with one fifth of his farm deeded to us now, and will, on our part, guarantee that his sons will, if the New-York Farmer is thoroughly read by them, soon be brought to look upon farming as the most learned and honorable of human callings. While we are on this subject, we would direct the attention of our correspondent to the following extract from an Address delivered by the Rev. Gardner Perry, before the Essex County Agricultural Society, (Mass.) at the annual Cattle Show, in 1832:

"Another hindrance in the way of agricultural improvement is an impression entertained by many that farming is not so genteel and honorable as some other employment. How this feeling grew up, (a feeling in the extent to which it exists among us almost peculiar to New-England,) I shall not attempt to decide; sure I am of its existence and of its baneful influence, though, like the

one just before mentioned, operating with somewhat diminished force. It has dried up the spirit and held the mind of many a noble and virtuous youth in bondage, suffused many innocent cheeks with a blush, prevented many ingenious and stirring spirits from going into that employment, whose taste and interest would otherwise lead them to it, and induced those who were engaged in it to work with less vigor, to seek for improvement with less interest, and frequently to turn all their originating and inventive powers into other channels, even when farming was still their real occupation.

"Who can look for a moment to the nature and operations of this society and the men who compose it, and not perceive how powerfully its influence must tend to remove an impression so unfounded in principle, so hurtful in its tendency. The example of the rich, the learned and distinguished men who give life and interest to this Society, comes in upon the soul of many a laboring youth like a refreshing and gladdening shower upon the thirsty land and withering herb.

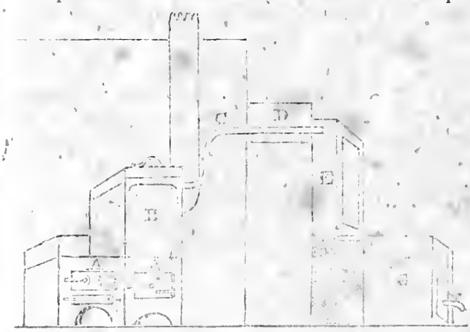
"The story that Pickering, the founder, and for many years the worthy and efficient President of this Society, held the plough, handled the spade, and looked well to the stall, has a thousand times been told, and whenever told has poured fresh courage and joy into the mind of many a toiling youth, who, humbled under the impression of which I am speaking, was tempted to blame his fate, which, in his apprehension, had cruelly chained him to a farmer's life.

"Another obstacle in the way of agricultural improvement, is a too general impression entertained that learning is of little advantage in the business of a farmer's life. Were it not for observations on other subjects, which I wish for special reasons to make, I should like to dwell a little on this point. As it is, I must content myself by observing, that in my apprehension there is no other employment in which there is a constant demand for manual labor, where there is so loud a call for the aids of science, or where the suggestions of a well instructed mind would prove a more efficient help. For proof of the correctness of this opinion, I have no occasion to go beyond the limits of this county, or out of the catalogue of the members of this society. Were I to train a child for the labors of the field, my first care would be to make him familiar, not perhaps with either ancient or modern languages, though if possessed of common sense they would do him no hurt, yet with the physical sciences: in all which I would have him as carefully instructed as if he were to go into professional life. Knowledge is power, power in the field as well as in the senate-house, power over matter as well as over mind."

Apparatus for freshening Salt Water. By E. W. B. [From the London Mechanics' Magazine.]

Dear Sir—I beg to submit for insertion in your truly valuable Magazine, the design of an apparatus intended to remedy the dreadful consequences arising from want of fresh water on board of ships. The apparatus by which this immense advantage may be obtained is so simple, and will occupy so little room, that there is no vessel which might not readily avail itself of it.

It is well known that the steam arising from salt water is perfectly fresh. If, therefore, this steam were conveyed, by means of a pipe attached to the copper, through a trough of cold water, which would act as a condenser, and if the water thus obtained were then passed through a filterer, it would be furnished for use not only in a fresh but in a very pure state. In the accompanying sketch, A A represents the stove (one of Frazer's pa-



tent sort); B, the copper; C, the steam pipe; D, the cold water condensing trough; E, a well for the reception of the water to be purified, which is half filled with sand, and coarse gravel on the top of it, and communicates at the bottom with another well, F, only half the height of the former, and which is also to be filled, excepting two or three inches, with coarse sand. The water, after filtering downwards through the first well, ascends through and accumulates on the top of the sand in the second, whence it passes over into the reservoir, G.

If, from frequent use, the apparatus should get in the least clogged, it may be cleansed in a few minutes, with the utmost facility, by

merely washing the sand and gravel, and thoroughly rinsing the pipes.

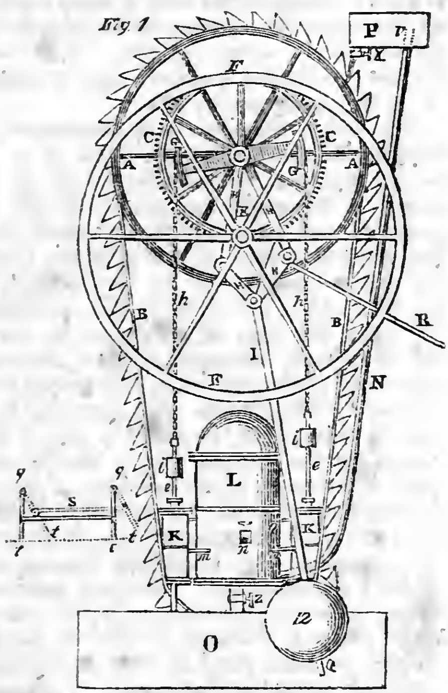
Much, of course, will depend on the size and purity of the sand, which will not always afford the same results. I have found that a prolongation of the stratum of sand does not much impede the produce of the filterer, but materially contributes to the purity of the water, which, it is not exaggeration to say, may be had by this means equal to the best spring water.

[In another number of the Mechanics' Magazine, we find the following, in relation to the preceding invention :]

Salt Water Freshening Apparatus.—Dear Sir: Since I forwarded the sketch of the apparatus for freshening salt water, which you was kind enough to insert in your last number, I have found that the pipe for the steam must be in the shape of a syphon, and not as shewn in your engraving ; for I find that the motion of the ship, when there is the least wind, would otherwise send the water back into the boilers. There ought also to be a cock inserted in that part of the pipe which is close to the boiler, so that the steam might be turned off when required; for in Fraser's patent stoves most of the vegetables are cooked by steam. There might also be a pipe led from the condenser to the boiler, so that when the water becomes warm from the action of the steam in the pipe, it could be discharged into the boiler. I remain, dear sir, your obedient servant,

Edw. Whitley Baker, jun.]

Fig. 1



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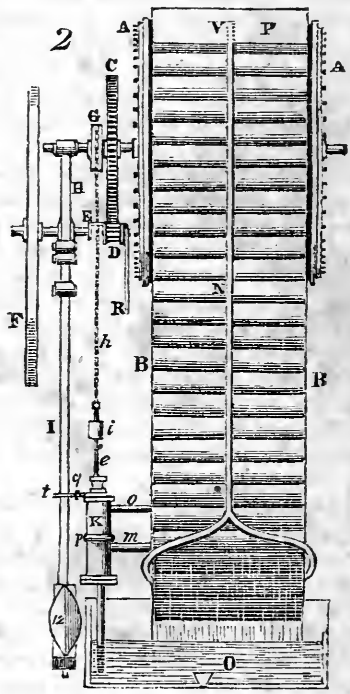


Pierre Nicholas Hainsselin's Machine or Motive Power for giving Motion to Machinery of different descriptions, to be called "Hainsselin's Motive Power." [From the Repertory of Arts, &c. for March.]

No. 1 represents a front view of the machine, and No. 2 a side view; similar letters of reference are used to denote similar parts in each view. A A is a large drum; B B, an endless series of reservoirs, or (as they would be called on a water-wheel) buckets, each fastened by a hinge joint to the other, so as to form an endless chain passing over the drum; C C is a cogged wheel, working into the pinion D, and E is an eccentric, more particularly explained hereafter; F F is a fly-wheel; G G is a balance beam, carrying the segment of a circle at each end; H H H H is what I call an escapement for I, which is a pendulum, and I 2 is the weight of the pendulum; K K are two pumps; L is the main cylinder of the machine; M, an air pump; N, a pipe

through which the water which works the engine is raised; O is a reservoir to receive the water from the descending buckets, and P a reservoir to receive the water from the pipe N.

When it is required to make one of the said machines, the following details must be observed: Suppose, for instance, it is required to make one on my plan, equal in power to a steam engine of which the expansive force is equal to a resistance of 1,000 lbs. in a second. It will be seen that air and water are the two principal agents in my machine. Water, it is known, weighs from 60 to 62 lbs. the cubic foot, and it requires 32 cubic feet of air to balance one cubic foot of water; and I have found by various experiments, that my machine employs about three-fourths of its power to produce its own action. From these premises it results, that, in order to have a machine on my plan equal to 1,000 lbs. per second, there must be 4,000 lbs. of water in the descending buckets, and 200 cubic feet of air condensed in the cylinder L, by means of the air pump M, which is worked by hand by a lever handle.

The drawing represents 64 buckets, fastened together by hinge-joints, in such a manner as to form an endless chain of buckets, their motion being so contrived that they descend full at one side of the drum, and rise empty at the other side; the drum being about 3 feet 6 inches in diameter, 25 of these buckets can retain water at the same time, and in order that the united weight of their contents may be 4,000 lbs. it is necessary that each of the 64 buckets shall be of a size (whatever be their form) conveniently to hold 160 lbs. of water.

In order to supply the 25 descending buckets with the required quantity of water, the two pumps K K are placed a little above the lower reservoir O; the rods of these pumps plumb with the extremities of the balance beam G G, by which they are worked.

The capacity of each of these pumps should be such, that each stroke of the piston should raise a column of water to the upper reservoir P, sufficient for the supply of one bucket, that is to say, 100 lbs. These pumps, which may be called hydropneumatic, are nearly like ordinary lift-pumps, the only difference being that the pump chamber is divided into two parts by the division *p*, the upper part being furnished with the piston of a force pump; the same rod, *e*, works both the piston of the upper part of the pump chamber, and the valve of the lower part of the chamber. The pump rods *e e* are fixed to a chain *h h*, which is attached to the segments on the ends of the balance beam G G, and thereby made to work the pump rods, while the balance weights *i i*, below the extremities of these chains, keep them at a proper degree of tension, and keep the beam on a just balance. The strong cast iron cylinder L must be capable of resisting the force of the condensed air which it is intended to contain, say at least 240 lbs. The interior of this cylinder is furnished with a division, by which an upper and lower chamber is formed, the lower is intended to receive the water which the pumps K K feed it with, by means of the pipes *m m*, at every stroke of their pistons; and in this chamber the water frees itself from the air which may have been pumped in with it, and which is suffered from time to time to escape at the cock *n*, when a quantity has collected sufficient in any way to retard the action of the machine. It is from this lower chamber that the water is supplied to the upper reservoir P.

The upper chamber of the cylinder L is destined to receive the air which is to be forced into, and thus condensed in it, by means of the small air pump. It will be seen that two pipes *o o* communicated with the upper chamber of the cylinder L and the upper chamber of the two pumps K K: these pipes are to let in the condensed air upon the tops of the piston, to cause the downward movement of their alternate action; *q q* are two valves, each furnished with a lever *t t*, which levers are connected by a pointed cross-bar S, as shown in plan in the margin of the drawing No. 1. As the two arms or levers *t t* of this contrivance project beyond the vertical line of the pendulum I, they are acted upon alternately by the vibration of the pendulum, thus alternately opening and shutting the valves *q q*. The lower reservoir O may be of any convenient capacity, but the upper reservoir P should at least be able to contain as much water as 25 of the buckets can hold, and the ascending pipe N, through which the water is raised from the lower chamber of the cylinder L, to the upper reservoir P, should be of such a diameter as to contain exactly the quantity of water required to fill three of the buckets.

The cock X is to regulate the descent of the water from the reservoir P into the buckets, which should be just equal to what is pumped up by each pump at each stroke of the piston. An air cock is attached to the top of the upper chamber of the cylinder L, and is to let a portion of the condensed air es-

cape when its too great density causes the engine to work at too rapid a rate.

Z is a cock for emptying the lower chamber of the cylinder L, when necessary for repairs or otherwise, and a similar cock or valve should be made to the lower reservoir O, in case, at any time, it should be required to empty it.

As it is necessary that each bucket as it empties itself should be replaced by a full one, the pinion D should be so regulated with reference to the toothed wheel *c* (which is fixed on the same axis as the drum A) that at every half revolution of the fly-wheel F, (which gears in with the pinion D, and is on the same axis with the eccentric E,) one of the buckets shall present itself in turn under the cock X to be filled.

The pendulum I is fixed on the same axis as the balance beam G G, and the object of the eccentric fixed on the axis of the fly-wheel is to act upon that part of the pendulum which I call the escapement, at *r*, thus propelling the pendulum to one side, while, as soon as the eccentric turns away from *r*, and it thus escapes from the action of the eccentric for a time, its own weight brings it back to be acted upon by the eccentric again, thus keeping up the vibration of the pendulum. The jointed bars at H H H H, which I have called the escapement, form a part of the rod I. This rod is furnished with the weight I 2, which may be raised or lowered on the rod I, by turning it to the right or reft on the thread of the screw Q, to regulate the motion of the pendulum, and this motion may be further regulated by the segment bar and adjusting screw K, which expands or contracts the jointed bars H H H H of the escapement at pleasure, and thus allows an increased or diminished action of the eccentric on the part *r* of the escapement.

R is a lever to throw the pinion D in and out of gear with the fly-wheel F, in order to stop the machine, or put it in action when required, and it may be well here to describe that this is effected by means of a small arm, which, when in gear, protrudes through a hole in the flange; O O of the pinion is drawn away from this arm, the fly-wheel and all upon its axis stops, and the pinion turns harmlessly with the toothed wheel.

Having now described the various parts of my said invention, and their several uses, I will proceed to describe the mode of putting the machine in operation. First, put a sufficient quantity of water in the reservoir P to fill 25 of the buckets, and about the same quantity in the reservoir O; then open the cock, X, of the upper reservoir, and by means of the lever R, throw the fly-wheel out of gear with the pinion D. By continuing to press lightly on this lever, R, it will cause the flange, *o o*, to rub against the wheel *c*, which it must, by means of the friction thus caused, be allowed to turn slowly, so as to give time to the 25 buckets to fill themselves. The moment the whole of the 25 buckets are full, the pinion must be smartly thrown into gear with the fly-wheel F, and by means of the lever *a* of the air pump M, the upper chamber of the cylinder L must be charged with air. It will be known when it is full by the sudden resistance the air will make when that is the case. The two foregoing operations will only be necessary when the machine is put in motion for the first time, or when afterwards, for any purpose, it may have been emptied of its air and water.

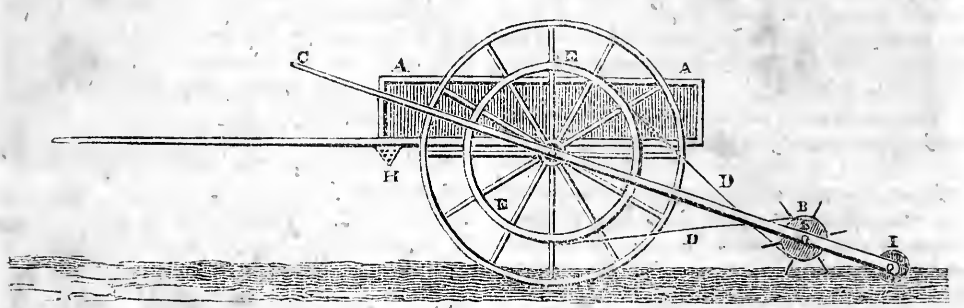
The machine is now ready to act, and it will only be necessary to give the first impulse to the pendulum, which, being done, the weight of the water in the 25 full buckets will cause the drum to rotate, as also the toothed wheel *c*; this will act upon the pinion D, which it worked into, and will cause the eccentric E, and the fly-wheel F, which are fixed upon the same axis, to revolve, the fly-wheel being so arranged as to make just half a revolution during each vibration of the pendulum.

The eccentric E, which is fixed upon the axis as the fly-wheel, will always act upon the pendulum, and secure to it its vibrating motion while the length of the strike will be easily determined by opening or shutting the escapement H, which is performed by turning the screw either to the right or left, as the case may be.

By raising or lowering the weight, I, 2, so as to make the vibration of the pendulum correspond with the speed of the fly-wheel. This weight, I, 2, should be of such a weight that when vibrating by its own weight, only, it will have the power to give full three strokes to the pumps K K. This pendulum, which is fixed on the same axis as the balance beam G G, will give an alternate movement up and down to each arm and segment of the beam, and these segments being connected with the rods *e e*, of the pumps K K, by means of the chains *h h*, their motion will work the pumps, and raise the water from the lower reservoir O to the upper P, through the lower chamber, of the cylinder L, and the ascending pipe N, whence it will flow again through the cock X, to fill in succession the 64 buckets of the machine.

The pendulum I, in its passage from * to *, strikes alternately the arms of the lever *t t*, which opens and shuts the valves *q q*, in order alternately to let escape and confine the air in the upper chamber of the cylinder L. The portion of the air which the alternate motion of the valves *q q* allows to pass into the upper chamber of the pumps K K expands, and acting with all its force on the upper side of the piston *d*, forces it down to the small openings *p p*, cut in the chamber for that purpose, and, escaping there, relieves the piston of the pressure, while the balance weights, *i i*, keep the chain, *h h*, stretched out, and the balance beam G G in equilibrio. —In order to preserve the density of the air in the upper chamber of the cylinder L, the operator must occasionally pump the chamber full of air, by means of the pump M; if this be done every five or six minutes, it will prevent the necessity of spending two hours when the machine first starts to charge the chamber.

Now, whereas it is evident that the power of the machine hereinbefore described may be applied to any of the ordinary purposes for which the power of steam-engines are now used, I claim it as my invention, &c., &c.



Machine for Harrowing, Sowing, and Rolling. By James D. Woodside. To the Editor of the New-York Farmer, and American Gardener's Magazine.

Sir,—I have recently invented and tested what judges esteem a valuable improvement in the harrow. It consists of a revolving cylinder, containing 45 feet, which is revolved by a power obtained from the wheels of a cart, to which it is with ease attached and detached. In addition to the harrow, there is a convenience for sowing the grain in front of the cart, by supplying a hopper, from which it is conveyed into a sieve, so constructed as to distribute it from wheel to wheel. The cylinder harrow in the rear of the cart effectually covers the grain. Attached to this is another cylinder used as a roller. From the above it will be perceived that I can of a truth affirm, that I can sit in the front of my cart, under a canvas covering, sow the grain, harrow and roll it in, without exposure to the sun, leaving the ground without any impression of the horses' feet, my own feet, or the cart wheels.

You will perceive by the crossing of the band, that the cylinder has a counter motion to that of the cart wheels, making 12 revolutions while the wheels of the cart make one.

References.—AA, the cart; B, cylinder; C, shaft on one side, with a power to elevate or depress the cylinder; D D, chain-band; E E, the V groove-wheel; F, do. do. on the end of the cylinder; H, the end of the sieve; I, the roller. The hopper is inside the front of the cart, and not seen.

Highly competent judges have approved of the machine, and I think the advantages great. I am advised by Mr. Van Kleek, of your State, who has witnessed its operations, to exhibit it at Albany, before Mr. Van Rensselaer, and other patrons of agriculture in that vicinity. This I shall do as soon as I conveniently can.

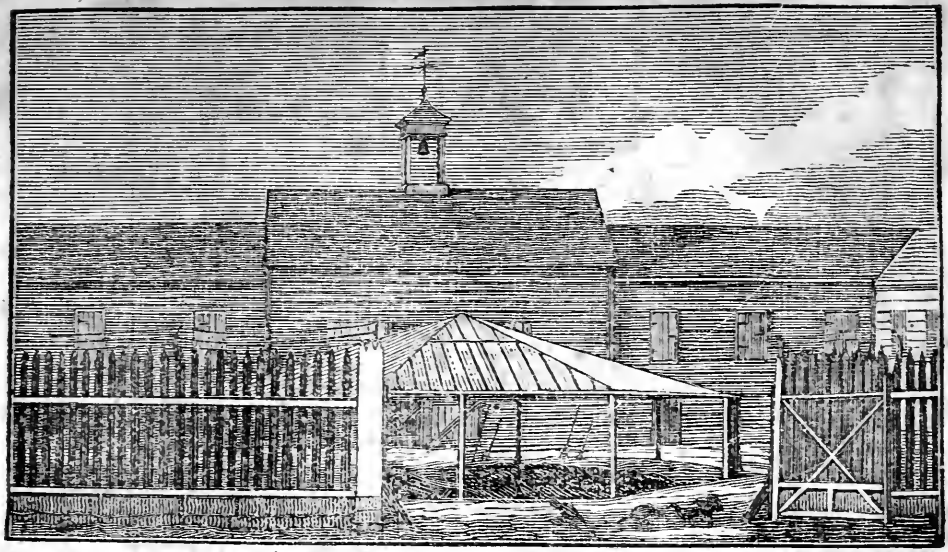
It is my determination to dispose of only a half or fourth of a right to a state, until it shall recommend itself to the public. Although the invention has been patented by me nearly a year, yet I have not heretofore brought it into any notice, having been determined to perfect it as far as possible before exhibiting it.

Your very obedient servant,

James D. Woodside.

Washington City, D. C., May 9, 1833.

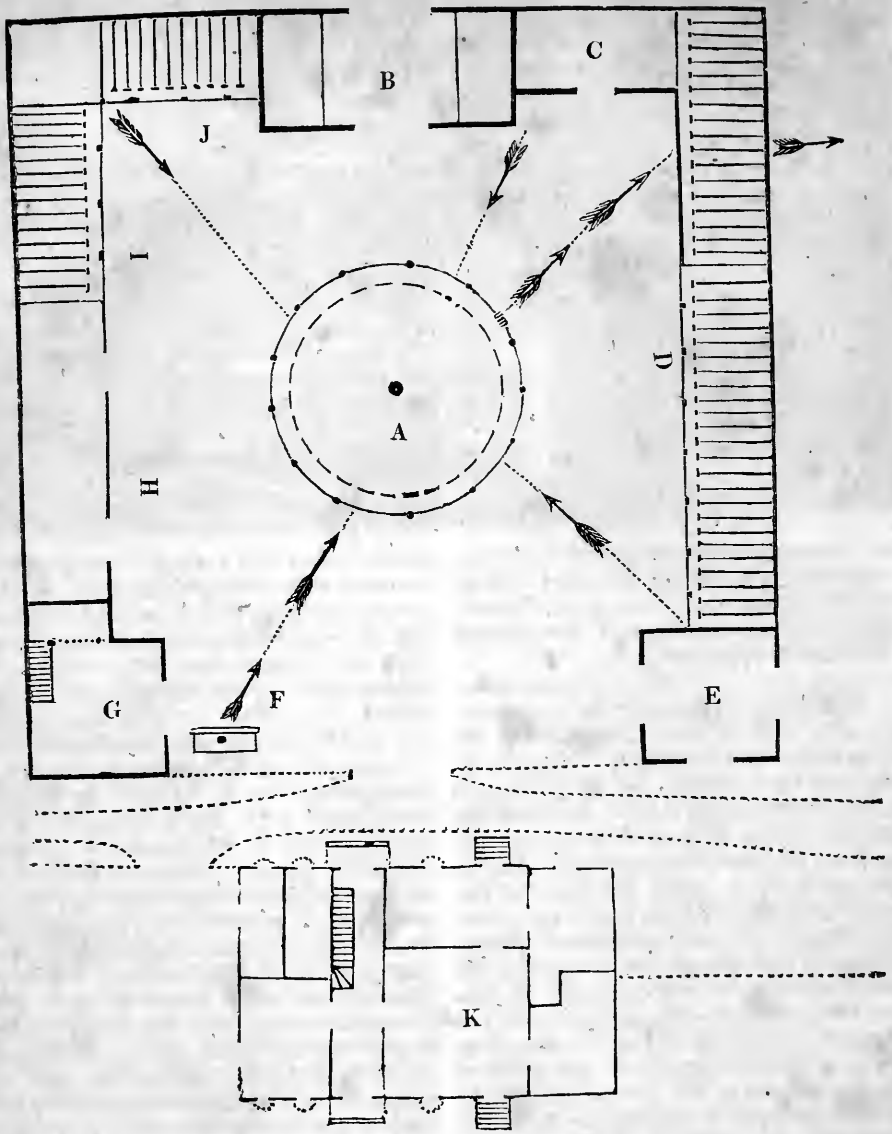
Remarks.—We think very favorably of the above, and hope farmers will show a prompt disposition to favor the inventor, who, we understand, devised the plan and superintended the work of placing the colossal statue of Washington on the summit of the Monument in Baltimore.—[Ed.]



Description of an Improved Stercorary—communicated in a Letter to Dr. James Mease, of the Agricultural Society of Philadelphia, by DAVID HOSACK, M. D. [For the Mechanics' Magazine.]

NEW-YORK, May 1, 1833.

DEAR SIR,—When you did me the favor of a visit at Hyde Park, during the last summer, you expressed a wish to receive from me a sketch and description of the shed or stercorary I have erected in my barn-yard for the purpose of preserving and improving the qualities of manure. Having many years since, when Professor of Botany in Columbia College, taught the principles of vegetation and agriculture as connected with that department of science, and discoursed upon the food of plants, the nature and qualities of soils and manures, you will readily believe that upon removing into the country and engaging in the practical duties of farming, my attention would be primarily directed to accumulate, preserve, and improve the contents of the barn-yard, as constituting the essence, or, as it may be called, the *vital principles* of successful agriculture. For this purpose, while my neighbors are in the habit of exposing their manure to the air and the sun, or accumulating it in cellars, I was induced to erect the shed, or umbrella, exhibited in the annexed plate. I should premise that the barn and other buildings surrounding the barn-yard occupy three sides of a hollow square, each side being 175 feet in extent. The stercorary is placed in the centre of the barn-yard, and is covered by a shed in the form of an umbrella; this is erected immediately above the manure heap, for the purpose of preventing the evaporation of the manure in summer, at the same time that it serves as a shelter for the cattle during a storm. The shed is about *forty feet* diameter; the centre post sustaining it is *thirteen feet* high; the posts in the circumference are *ten feet* in height and *ten* in number, allowing sufficient space for a cart or a waggon to pass between them for the deposite or the removal of the manure; the top is covered with common unplaned boards, and the whole roof is washed or painted over with a mixture of tar, oil, and sand, and colored with a small proportion of Spanish brown, by which composition it is partly preserved from decay. You will recollect that the barn-yard is so formed that the centre of it is excavated in the form of a dish, while all the other adjacent parts of it are gradually inclined to the centre, gravelled and rolled, so that every portion of the yard is preserved dry, hard, and clean. Small paved drains for conveying the *stale* from the cattle sheds and stables, communicate with the centre. In case of rain, the water from the adjoining buildings also flows to the reservoir, and when the dish or excavation may overflow, a covered stone drain, with an iron grating at its mouth, conveys the surplus liquid parts of the manure to a large tank, or cistern, holding about 60 hogsheads, situated in the garden, from whence it is raised by a pump at the pleasure of the gardener, who finds in



this a valuable and rich resource for his vegetables. By this contrivance no part of the manure of the yard is lost. The above mentioned shed, by placing a frame work like the small braces of an umbrella at the upper part of it, is also devoted to the purposes of a roost for poultry; this, too, at the same time that it affords an ample and warm protection for fowls, in some degree attracts them to that part of the barn-yard, and thereby preserves the remainder of it relatively clean, for it is to be recollected that they spend a great portion of the day upon the manure heap, as well as lodging above it during the night. They are also regularly fed in the barn-yard, which attaches them to it, and prevents them from wandering far from their home. The fowls also have access to the cattle sheds, and to the sheep cellar beneath the barn, where they make their nests; by this arrangement, while the family is most abundantly supplied with the produce of the poultry yard, the fowls are protected from their natural enemies.

References.—A, the stercorary; B, the barn; C, straw house; D, cattle and horse

stables, with sheep cellar beneath; E, waggon-house; F, well and trough, for watering the cattle; G, cider mill, with the cider press adjoining, next to H; H, apartment for sheep shearing, with cider cellar beneath; I J, cow stalls, with a root cellar situated in the centre; K, farm-house and dairy beneath.

If this communication should contain any hints that may prove beneficial, I will be gratified in complying with your request.

Origin of the Corinthian Order of Architecture. By F. To the Editor of the Mechanics' Magazine.

Sir,—In the remarks upon the Corinthian Order of Architecture, contained in the extract from Partington, in a recent number of the Mechanics' Magazine, I perceive that the origin of it is attributed to the Greeks. The authority for this is derived from Vitruvius, whose account of the discovery is as follows: A marriageable young lady of Corinth sickened and died. Her nurse, entertaining a very great affection for her, placed sundry ornaments with which she used to be pleased in a basket near her tomb, and covered the same with a tile. The next spring, an Acanthus, or Bear's-breach, sprang up around the basket, the leaves of which, on meeting with the tile, curved downwards like volutes, and the sculptor Callimachus accidentally observing it, drew from thence the first idea of the Corinthian Order. Although the story is well told, and at first sight may seem quite plausible, yet it exhibits so many incidents of a peculiarly interesting character in so close a connection, such as the youth and marriageable age of the lady, affection of the nurse, &c. as to lead to the belief that, if it be true in the main, it must have received considerable embellishment. That the order may have been improved by some such circumstance as related above, is perhaps not improbable, but that it originated with the Greeks cannot be well credited, for we find that the Egyptians long before "formed the caps or upper part of their columns into elegant vase shapes, decorated with the stalks, leaves, buds, and blossoms, of the lotus or lily of the Nile, and occasionally the leaves of the palm, vine, papyrus, and date, were introduced." (See Civil Architecture, Ed. Encyclopædia, p. 424, and likewise plate C L of the same work, where are representations of several Egyptian Capitals, having a remarkable striking resemblance to the Corinthian.) In the article above referred to, we are cautioned "not to overlook, in the warmth of our devotion for the inspiration of Grecian genius, the facts, that in the pillars of several of the temples in upper Egypt, whose shafts represented bundles of reeds or lotus bound together in several places by fillets, the capitals are formed by several rows of delicate leaves. In the splendid ruins of Vellore, in Hindostan, the capitals are also composed of similar ornaments; and it is likewise well known that the Persians at their great festivals were in the habit of decorating with flowers the tops of the pillars which formed their public apartments. It is therefore not improbable that these circumstances, after so much intercourse with those countries, might have suggested ideas to Callimachus, which enabled him to surpass the capital of Ionia." It is farther added, that "the Egyptians introduced human figures in place of columns. The Greeks did the same, claiming the invention and naming them Caryatides." There can be little doubt that the Termini of the Romans had a similar origin.

They are not inaptly compared to the "figure of a man stuck into a sheath," and are merely imitations of mummies, which occur frequently in the architecture of the Catacombs. F.

New Fire—Mr. J. Hancock, of Fulham, has, we are assured, invented a compound which burns under water, and which continues inflammable in any accumulation of moisture. It is in all respects similar to the much celebrated *Greek Fire.* He proposes to apply it not to human destruction, but to the saving of the lives of miners. It is the most perfect and unerring fuse for blasting ever contrived; the wet damp, and water, which often interfere, being no hindrance to its perfect and definite action. It may, too, be accommodated to time, as a yard will burn out in one or two minutes, or in five or six minutes as desired. It is moreover as cheap as any fuse that ever was made.—[London Lit. Gazette, Ap. 6.]

Society of Mechanics to improve Architecture.—An association of mechanics has been formed at New-Haven to improve the style and taste in architectural structures. The objects coming within the purview of the society are numerous, not only the style of dwellings, but of all the outbuildings, their adaptation for the comfort and convenience of man and beast, the economy and durability of the materials, and the best means of ventilating and warming the apart-

ments, are among the subjects embraced. Such an association should exist in every considerable village, as well as larger town and city. Agricultural and Horticultural Associations should give at least some attention to this subject, and have a division of the members devoted to it.—[N. Y. Farmer.]

"Pray, Mr. Abernethy, what is a cure for the gout?" was the question of an indolent and luxurious citizen. "Live upon sixpence a day—and earn it;" was the pithy answer. —[Annual Biography and Obituary for 1832.]

MONTHLY ANALYSIS OF SCIENTIFIC PERIODICALS FOR APRIL.

The London Mechanics' Magazine contains a great quantity of useful matter. Among the best is a review of

"Dr. Lardner's Book on Heat"—to the merits of which the Editor has done ample justice, as does his correspondent, Mr. J. O. N. Rutter: the latter states, "It is an elegantly written work, and no trifling praise for it is to say that it deserves a place on the same shelf with Herschel's Introduction to the Study of Natural Philosophy."

"Henneky's Guage for Standing Casks," (with cuts,) copied from the Transactions of the Society of Arts, we shall take the liberty of transferring to our columns next month.

The Review of the "Penny Cyclopædia" of the Society of Useful Knowledge is written in the Editor's happiest manner. The Society certainly deserve great censure for issuing under their sanction a work with so many palpable errors—errors that would disgrace the merest tyro in literature.

"Lawton's Safety Lock."—Judging from the description and plates, we should think this the best ever invented. The inventor has offered £110 to any one who can pick it with false keys. Very many have been the attempts in England to produce a Safety Lock; Mr. Chubbs approached nearer to perfection than any, but (if we remember rightly) an old house-breaker, in confinement at the Hulks at Sheerness, succeeded in opening it by skeleton keys, in the presence of the inventor and other persons interested.

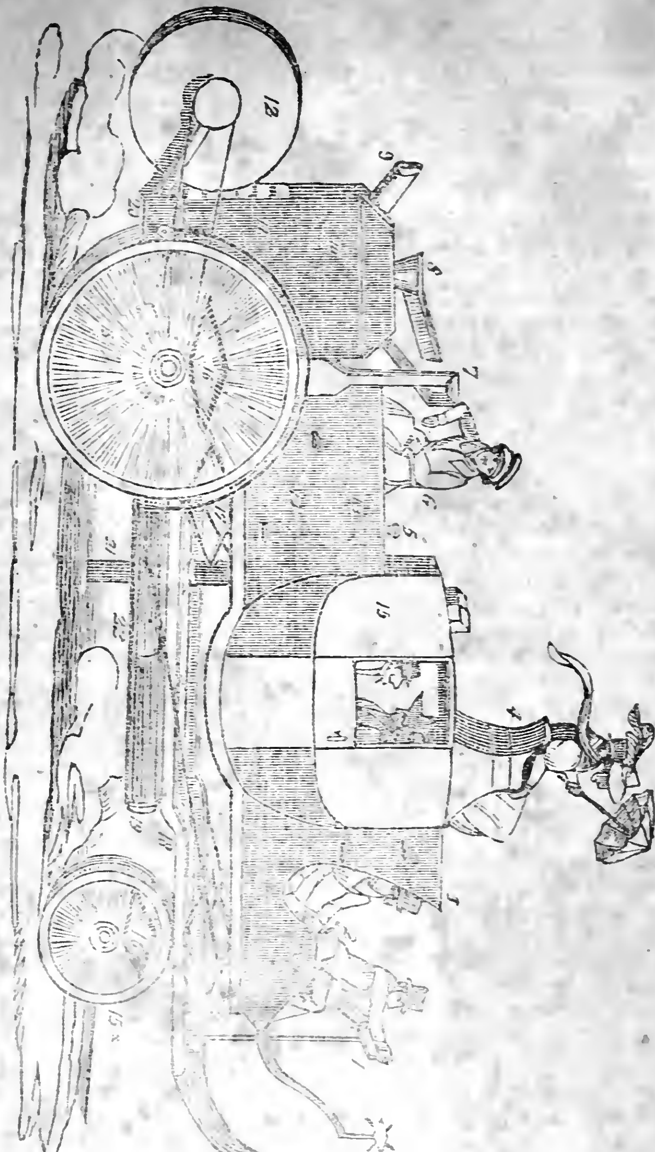
Upon the whole, we think greater than usual care has been taken to make this month's number interesting and useful; the wood cuts are well executed, and the printers (Messrs. Cunningham & Salmon) deserve every commendation for the workmanlike manner in which they have issued it from the press.

In our last we alluded to the Editor's review of Mr. Gordon's Locomotive Journal, (p. 213)—where, speaking of Steam Travelling on Common Roads," he says "*The thing on a common road is impossible, nature and art alike forbid it.*" Mr. Ogle has replied in a very sensible, and in our minds conclusive manner, to the above assertion: from the following extracts from his evidence before the House of Commons, it appears that "the travelling by steam on common roads at the rate of 20 miles an hour is not 'impossible,' and 'the thing' is not 'forbid by nature and art.'" Mr. Ogle states that "his steam carriage went from the turnpike gate at Southampton to the four-mile stone on the London road, *a continued elevation*, with one *very slight descent*, at the rate of 24½ miles an hour, loaded with people." Mr. O. further states that he has done so several times on that and on *other* lines of road *more trying*. He also mentions the names of several distinguished scientific individuals, who accompanied him, and timed the rate of going: on one occasion he accomplished three and a half miles in five minutes and a half. Mr. O. concludes his letter thus, "After some experience, I venture to affirm that *twenty* miles an hour are to be cleared between London and Edinburgh."

We should infer that he (the Editor) meant it was impossible to travel on a common road by steam power, at all; however, he now admits the possibility of travelling from 10 to 13 miles an hour in that manner. We cannot divine why a steam drag should not convey passengers 20 miles an hour; it is quite evident from the testimony of Mr. Ogle, and his partner, Mr. Summers, and corroborated by Mr. Gurney, that it has been accomplished, and we see nothing that would induce us to think with the Editor of the London Mechanics' Magazine, that the project is "conceived in an *ignorant* and visionary spirit."

The Editor, in reply to a very sensible communication on the same subject, signed "Animo," comments pretty freely on Mr. Ogle's testimony, occasionally with more warmth and less courtesy than is generally used on such occasions. Both Mr. Gurney and Mr. Gordon, are, we know, good practical judges of such matters, and in their hands we leave it, trusting that they will favor us with ample testimony of the practicability or inutility of the attempt; at present, we would say to the Editor of the "London Mechanics' Magazine," in the words of his own correspondent, Animo, "If the thing be fudge, and you have it in your power to prove it to be such, pray do not trifle with us by

mere oracular assertions—prove it."



The annexed drawing, copied from "Bell's Weekly Messenger," is, we are informed, a correct representation of Messrs. Ogle and Summers' steam carriage, alluded to by Mr. Ogle in his evidence before the committee of the House of Commons, in which they travelled from Southampton to Liverpool, *via* Oxford and Birmingham, a distance of 200 miles, as they performed it.

REFERENCES—1. Helm by which the carriage is guided; 2. Seat for the conductor: 3. Coupe, like French Diligences, for four persons; 4. Seat for outside passengers: 5. Hand-pump for filling tanks; 6. Seat for engineer; 7. Pipe for surplus steam; 8. Jigger by which the furnace is fed; 9. Flue, or chimney; 10. Boiler; 11. Furnace; 12. A Blower, worked by a strap round the axle; 13. Water Tank; 14. Break to check speed, regulated by a lever to the conductor' seat; 15. Carriage for eight inside; 15*. Wheels, very strong, the spokes not here marked; 16. Springs on which the machinery rides; 17. Springs on which the carriage rests; 18. Frame connecting the whole; 19. Machinery, under the carriage; 20. Ash Box, under the furnace; 21. Pump by which the engine forces the water into the tanks; 22. Piston for working the pump.

The Franklin Journal contains a complete refutation of the claims set up by Professor Daniels, alluded to in our last, for inventing the Oxy-hydrogen Jet, it is made quite clear that its original inventor was Dr. Hare, and the description of it appeared in print in Tilloch's Philosophical Magazine, so long ago as the year 1802. Among the patents there is nothing very material. There is an interesting beginning article on the Art of Glass Blowing, translated from the "Journal des Connaissances Usuelles;" and several minor articles selected from other scientific journals.

The Repertory of Inventions has nothing of much interest this month, excepting an account of a patent granted to Mr. W. Joyce, of Bow, near London, for an improvement in making collars for horses, thereby preventing the mischievous effects caused by the galling their necks, owing to the unequal bearing of the ordinary collars.

[This celebrated song is printed in several collections of Poems published in the sixteenth century. There are many variations in each of the copies. The following version is that given by Ritson, in his "English Songs," with the exception of the last stanza, which is from a MS. in the Bodleian Library at Oxford. In that manuscript the Poem is ascribed to Sir Edward Dyer, a friend of Sir Philip Sydney.]

My mind to me a kingdom is;
 Such perfect joy therein I find,
As far exceeds all earthly bliss,
 That God or Nature hath assign'd;
Though much I want that most would have,
Yet still my mind forbids to crave.

Content I live, this is my stay;
 I seek no more than may suffice;
I press to bear no haughty sway;
 Look what I lack, my mind supplies;
Lo! thus I triumph like a king,
Content with that my mind doth bring.

I see how plenty surfeits oft,
 And hasty climbers soonest fall;
I see that such as sit aloft
 Mishap doth threaten most of all:
These get with toil, and keep with fear;
Such cares my mind could never bear.

No princely pomp nor wealthy store,
 No force to win a victory;
No wily wit to salve a sore,
 No shape to win a lover's eye;
To none of these I yield as thrall;
For why? my mind despiseth all.

Some have too much, yet still they crave,
 I little have, yet seek no more;
They are but poor, though much they have,
 And I am rich with little store.
They poor, I rich; they beg, I give;
They lack, I lend; they pine, I live.

I laugh not at another's loss,
 I grudge not at another's gain;
No worldly wave my mind can toss,
 I brook that is another's bane:
I fear no foe, nor fawn on friend—
 I loath not life, nor dread mine end.

My wealth is health and perfect ease,
 My conscience clear my chief defence;
I never seek by bribes to please,
 Nor by desert to give offence.
Thus do I live, thus will I die—
Would all do so as well as I.

I joy not in no earthly bliss,
 I weigh not Crœsus' wealth a straw;
For care, I care not what it is—
 I fear not fortune's fatal law:
My mind is such as may not move
For beauty bright, or force of love.

I wish but what I have at will,
 I wander not to seek for more;
I like the plain, I climb no hill;
 In greatest storms I sit on shore,
And laugh at them that toil in vain
To get what must be lost again.

I kiss not where I wish to kill,
 I feign not love where most I hate;
I break no sleep to win my will,
 I wait not at the mighty's gate;
I scorn no poor, I fear no rich—
I feel no want, nor have too much.

Some weigh their pleasures by their lust,
 Their wisdom by their rage of will;
Their treasure is their only trust,
 A cloaked craft their store of skill;
But all the pleasure that I find,
Is to maintain a quiet mind.

METEOROLOGICAL RECORD, KEPT IN THE CITY OF NEW-YORK,

From the 30th day of April to the 31st of May, 1833, inclusive.

[Communicated for the Mechanics' Magazine and Register of Inventions and Improvements.]

Date	*Hours.*	*Thermometr.*	*Barometer.*	*Winds.*	*Strength of Wind.*	*Clouds from what direction.*	*Weather.*	
Apr. 30	6 a. m.	62	30·03	sw by w	light		cloudy	smoky
	10	81	30·08	..	..	{ NW / WSW }	fair	..
	2 p. m.	83	30·07	..	..	NW	..	..
	6	76	30·05	NE	fresh	..	..	..
	10	61	30·15	..	strong	..	cloudy	..
May 1	6 a. m.	56	30·21	NNE	moderate		foggy & cloudy	..
	10	60	30·25	NE	..	NW	fair	..
	2 p. m.	65	30·21	ENE	..	..	..	..
	6	57	30·20	SSE	..	..	..	..
	10	53	30·20	SE	..		cloudy	..
" 2	6 a. m.	52	30·10	SSW	..		..	..
	10	65	30·05	..	..		fair	..
	2 p. m.	74	30·00	..	..	SW	..	..
	6	69	30·05	SW	..	NW	..	..
	10	63	30·12	..	..	..	..	
" 3	6 a. m.	48	30·25	N	..		clear	
	10	54	30·26	NNE—ENE	light		..	
	2 p. m.	60	30·28	S	..	SW	fair	
	6	56	30·21	..	..	..	..	smoky
	10	53	30·26				..	..
" 4	6 a. m.	48	30·28	SW—S	faint	WSW	..	..
	10	57	30·32	SSE	moderate	..	..	..
	2 p. m.	53	30·29	..	..	..	cloudy—rainy	..
	6	51	30·26	..	..	..	rainy	
	10	48	30·22	..	..		cloudy	
" 5	6 a. m.	54	30·17	N	faint	NNW	..	
	10	55	30·19	NNW	light	..	..	
	2 p. m.	57	30·18	N by W	..	..	..	
	6	59	30·19	..	..	..	..	
	10	54	30·21				fair	

Remarks.

APRIL.

Arithmetical mean of the thermometer for the month, 52°.

Maximum height of the barometer in April, 30·40—Minimum, 29·42—Range, 0·98.

The observations of winds at the surface, for the month of April, show the following results: From NE. including N. 22—from SE. including E. 26½—from SW. including S. 63½—and from NW. including W. 23.

The observations of clouds or higher currents, also for the same month, are as follow: From the North-Eastern quarter, 4—from the South-Eastern, 3—from the South-Western, 65½—and from the North-Western, 28½.

METEOROLOGICAL RECORD, KEPT IN THE CITY OF NEW-YORK—CONTINUED.

Date.	*Hours.*	*Thermometr.*	*Barometer.*	*Winds.*	*Strength of Wind.*	*Clouds from what direction.*	*Weather.*
May 6	6 a. m	49	30·22	NE	faint	SW	fair—cloudy smoky
	10	52	30·25	SSW	moderate	..	cloudy—fair ..
	2 p. m.	63	30·20	S	..	..	fair ..
	6	57	30·15	SSE	..	..	.. ..
	10	56	30·14				.. ..
" 7	6 a. m.	54	30·13	SW	light	..	.. ..
	10	64	30·13	S	..	..	.. ..
	2 p. m.	76	30·08	..	..	..	.. ..
	6	74	29·98	variable	..		cloudy—thunder storm
	10	65	30·05		fresh		rain [from 7 to 8
" 8	6 a. m.	63	30.00	SW	light		cloudy
	10	68	29·95	SSE	..	S	fair
	2 p. m.	78	29·92	..	..	..	..
	6	71	29·89	WNW	..	WNW	cloudy—showers
	10	67	29·91		..		..
" 9	6 a. m.	64	29·97	NNW	..		..
	10	77	30·00	NNE	..	W	fair
	2 p. m.	78	30·01	E	..	..	..
	6	60	30·09	ESE	fresh	..	..
	10	54	30·17	..	..	..	..
" 10	6 a. m.	51	30·20	SE	moderate	..	..
	10	60	30·23	ESE	fresh	..	..
	2 p. m.	63	30·21	ENE	strong	SW	cloudy
	6	52	30·20	..	..	..	.. —rainy
	10	51	30·20	..	..	..	rainy
" 11	6 a. m.	54	30·12	ENE—E	moderate	S	.. , thick scuds fr SW
	10	56	30·12	SE—SSE	..	SW	cloudy ..
	2 p. m.	62	30·09	S	..	..	.. ..
	6	63	30·09	..	..	..	fair ..
	10	62	30·10	..	..	..	cloudy—rainy ..
" 12	6 a. m.	63	30·10	SSE	..		.. ..
	10	66	30·11	..	..	WSW / SW	fair—cloudy ..
	2 p. m.	70	30·06	..	fresh	..	cloudy—fair
	6	65	30·03	..	..	..	.. — ..
	10	63	30·03	..	..	..	.. — ..
" 13	6 a. m.	63	30·02	..	..	..	fair
	10	68	30·01	..	moderate	..	.. occasional showers
	2 p. m.	74	30·01	..	light	..	..
	6	65	30·00	..	..	..	..
	10	63	30·03	..	..	..	..
" 14	6 a. m.	63	30·08	SE	..	S	rainy
	10	68	30·11	S by E	..	..	cloudy
	2 p. m.	73	30·07	S	..	..	..
	6	65	30·03	SSE	..	SE	fair
	10	63	30·04	..	..	..	..
" 15	6 a. m.	65	30·00	..	..		rainy
	10	68	30·03	N	..		..
	2 p. m.	72	30·07	NNE	..	SW / NNE	cloudy Heavy freshets in the rivers.
	6	68	30·10	ENE	..	N	rainy
	10	66	30·12	..	..		cloudy
" 16	6 a. m.	59	30·18	NE	fresh		..
	10	59	30·16	..	..		..
	2 p. m.	58	30·15	..	strong	NNW	rainy
	6	52	30·15	..	..	..	..
	10	53	30·11	..	..		rain
" 17	6 a. m.	55	30·06	..	light		..
	10	61	30·05	..	..		cloudy
	2 p. m.	67	30·04	SSW	..	SW	fair
	6	64	30·01	..	..	..	..
	10	61	30·00	..	..		cloudy
" 18	6 a. m.	60	30.00	..	..	WSW	..
	10	66	29·98	..	moderate	..	..
	2 p. m.	76	29·88	..	..	W—NW	fair
	6	72	29·85	..	..	NW	..
	10	72	29·86	..	..		..
" 19	6 a. m.	70	29·85	SW	light	WSW	.. [cloudy
	10	76	29·87	SW by W	moderate	..	.. horizon mostly
	2 p. m.	82	29·86	WSW	..	..	.. ..
	6	76	29·83	..	..	WSW / NW	.. ..
	10	72	29·90	..	..		.. ..

Remarks.

MAY.

Arithmetical mean of the thermometer for the month, 62°.6.

Maximum height of the barometer, 30.37 in.—Minimum, 29.72—Range, 0.65.

The observations of surface winds for May give the following results: From the North-Eastern quarter of the compass, including N. 41½—from SE. including E. 55½—from SW. including S. 32—and from NW. including W. 13.

The observations of the highest observed clouds, or currents, result as follows: From the North-East'n quarter, 3—from the South-Eastern, 3—from the South-Western, 77½—and from the North-Western, 28½.

The long drought which prevailed after the breaking up of winter terminated with showers on the 7th and 8th of this month. These showers were in many places accompanied by hail. Heavy rains succeeded, particularly from about the 11th to the 15th, by which the rivers were greatly swollen and much damage was sustained.—The rains have been general throughout almost every part of the United States, commencing a little earlier at the West and South, but have been heaviest in the interior of the middle and eastern States. Since the 8th instant, the month has been remarkably wet for the season. It is worthy of remark, that the Barometer has stood considerably above 30 inches during almost the whole period of these rains, even during the deluge which was experienced in the country from the 10th to the 15th—a fact which shows that the production of rain has no *necessary* connection with the sinking of the mercury in the barometer.

Note.—The position of the barometer is but eight or ten feet above the level of the sea, and its adjustment to the scale is accurate, or nearly so.

METEOROLOGICAL RECORD, KEPT IN THE CITY OF NEW-YORK—CONTINUED.

Date.	*Hours.*	*Thermometr.*	*Barometer.*	*Winds.*	*Strength of Wind.*	*Clouds from what direction.*	*Weather.*
May 20	6 a. m.	68	29·93	NE—ENE	moderate	WSW	fair—cloudy
	10	61	29·99	ENE—E	..	..	cloudy
	2 p. m.	62	29·95	E	..		.. —rain
	6	60	29·95	..	..		rain
	10	58	29·93	..	..		rainy
" 21	6 a. m.	56	29·77	ENE	..		cloudy and foggy
	10	58	29·79	..	..	SW	.. —thund. sh'r at 1
	2 p. m.	60	29·74	E—SSE—S	..	..	.. — do. at 4
	6	66	29·72	S	..	..	.. —fair
	10	63	29·76		..		fair high *cirri* fr SSW
" 22	6 a. m.	61	29·87	NNW	..	SSW	..
	10	67	29·93	..		SSW / NNW	..
	2 p. m.	76	29·95	WSW	light		..
	6	72	29·98	..	..	W by S	..
	10	67	30·00	..	..	..	..
" 23	6 a. m.	63	30·10	N—NE	..	WSW	..
	10	65	30·15	NE—S		..	cloudy
	2 p. m.	70	30·13	S—SSE	moderate	..	..
	6	67	30·13	SE	..	..	..
	10	63	30·19		..		..
" 24	6 a. m.	58	30·27	NE	..	..	fair } with light cirrous clouds from WSW
	10	62	30·34	ENE	..	WSW / NNE	.. }
	2 p. m.	67	30·37	E—ESE	..	WSW / NE	.. —cloudy
	6	63	30·37	ESE	..	WSW	cloudy
	10	58	30·31		..		fair
" 25	6 a. m.	55	30·27	ENE	..	SW-slow / E	cloudy—fair—rainy
	10	57	30·27	..	..	E	rain
	2 p. m.	58	30·18	..	fresh	..	..
	6	56	30·10	..	..		..
	10	56	30·07		..		..
" 26	6 a. m.	53	29·98	NNW	moderate	NNW	fair
	10	66	29·96	NW—SW	light	NW—W	..
	2 p. m.	74	29·89	SW	..	W	..
	6	71	29·87	SSE	..	W—NNW	..
	10	66	29·90	NNW	..	WNW	.. thick scuds fr E
" 27	6 a. m.	62	29·94	ENE	moderate	WNW / E	..
	10	66	29·95	E—ESE	..	W-W by S / ESE	.. —cloudy
	2 p. m.	70	29·96	SE by E	..	WSW / E by E	cloudy
	6	65	30·03	ESE	..	SW / E	..
	10	61	30·00	E			rainy—rain
" 28	6 a. m.	59	30·03	ENE	..	ENE	.. , rain scud fr ENE
	10	60	30·05	..	..	..	..
	2 p. m.	61	30·16	NE	..	SW by S—low / ENE	..
	6	62	30·11	SNE	light	.. / ..	alternately fair & cloudy
	10	62	30·10	..	..	.. / ..	cloudy
" 29	6 a. m.	59	30·05	..	..		.. —clear
	10	62	30·02	E—ESE	moderate		cloudy & foggy
	2 p. m.	65	30·02	SE	..		.. .. } balloon
	6	60	29·85	..	..		.. .. } ascension
	10	59	29·77	..	..		rainy—rain
" 30	6 a. m.	57	29·79	NW	mod.-fr'h	NW	fair, with light scuds fr NW
	10	63	29·85	WNW	fresh	WNW	..
	2 p. m.	67	29·85	WNW—W	..	SW by W / WSW	..
	6	66	29·89	W—WSW	light	SW by W	.. —clear
	10	60	29·93	WSW	..		clear
" 31	6 a. m.	56	30·02	..	..	SW by W	fair
	10	64	30·05	SW	moderate	..	..
	2 p. m.	72	30·05	SSW—SSE	..	..	..
	6	67	30·03	S	..	..	..
	10	62	30·04	..	..	SW by W / W	..

Remarks.

Mr. Durant made an ascension with his balloon on the 29th. He left Castle Garden a few minutes after 5 o'clock, with the wind at *south-east*, and was out of sight from the Garden in 25 seconds, being enveloped with the clouds, which during most of the day were in contact with the earth's surface. In 6 minutes after leaving the earth he was above the clouds, *the heat had increased*, and he had clear sunshine, with a most magnificent prospect. On reaching the adjudged height of 16,000 feet, the cold became intense and he prepared to descend. On approaching the earth the noise of surf was heard, (probably from Hurlgate and its vicinity, where the tide of flood was running in its full strength,) the singing of birds was soon heard, and he landed about three quarters past 6 o'clock in Westchester county, eleven miles from the City Hall, three from the Hudson river and eight from the East river or Sound, which spot bears nearly *north-east* from the place of ascension.

It will appear from our record that on the previous day as well as at other recent periods, the upper current of stratum or clouds was observed moving steadily from west-south-west. It was this current which chiefly influenced the course of the balloon; and this ascension serves to strengthen the view which the writer has long entertained, viz. that during the cold winds and rains of our climate, particularly of the spring months, the warm and genial current of south-westerly winds, from the lower latitudes and the Gulf of Mexico, continues to move in its accustomed circuit without interruption, and forming, above the surface winds, a superincumbent stratum of no great elevation.

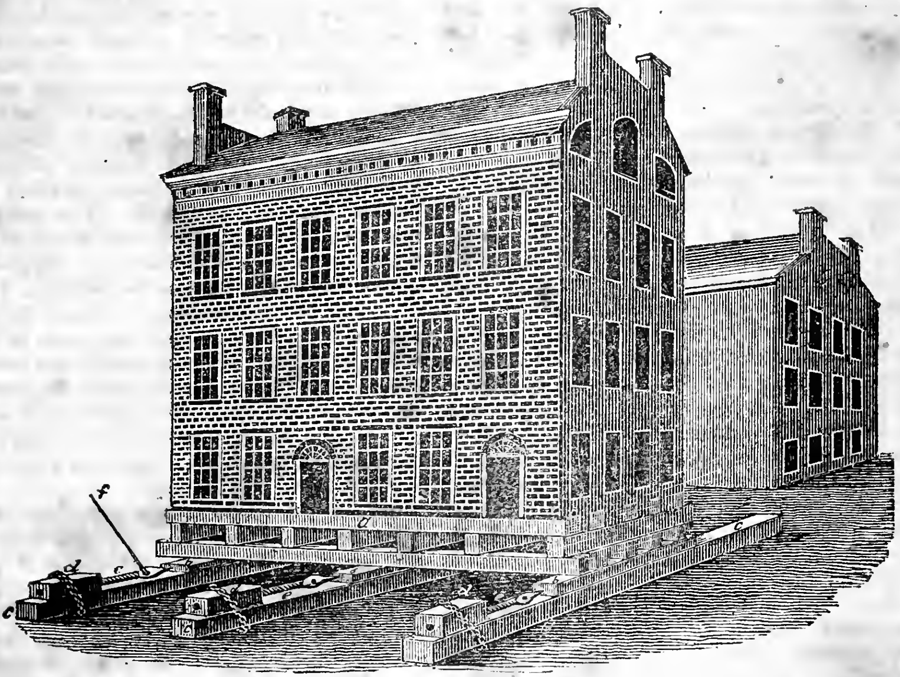
MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME I.] JUNE, 1833. [NUMBER 6.

"*Knowledge* dwells
In heads replete with thoughts of other men;
Wisdom, in minds attentive to their own.
Knowledge, a rude unprofitable mass,
The mere materials on which Wisdom builds,
Till smooth'd, and squared, and fitted to its place.
Does but encumber whom it seems t' enrich.
Knowledge is proud, that he has learn'd so much—
Wisdom is humble, that he knows no more."—COWPER.



Mr. Simeon Brown's Method of moving Brick Buildings. [Communicated by the Inventor for the Mechanics' Magazine.]

REFERENCES—*a a*, timbers placed in different directions, according to the construction of the building, so that it may be perfectly secure; *b b b*, the slides; *c c c*, the ways, on which the slides move; *d d d*, the pumps, (so named,) secured by chains to the ways, *c c c*, and containing the female screws, which are each provided with a shoulder, pressing against the end of the pump; *e e e*, the propelling screws, which are severally acted upon by a lever, *f*.

MR. SIMEON BROWN, Eastern Hall, Manhattan Island, has, by the simple apparatus as shown in the engraving, removed several

brick nouses, varying from one to three stories high. As we know that many people are quite incredulous on this subject, we subjoin a list of some few tenements that have been moved by Mr. B. in this city.

The first *brick* house Mr. Brown moved was situated at 85 Maiden lane; it is three stories high, and the size is 55 feet by 22. A short time afterwards he lowered Richmond Hill Theatre, a brick building, the wall 8 inches thick, size 50 feet by 42, and moved it a distance of 68 feet. Shortly afterwards seven brick houses, at one time and by one set of apparatus, in Monroe street, each 24 feet by 40; the numbers of the houses are 118, 120, 122, 124, 126, 128, and 130. Then nine brick houses, 25 feet by 40, situated in Avenue D, all raised 5 feet 2 inches, by one operation; and a three story brick house, 58 feet by 25, in Monroe street. The Church now situated in Sixth street, Greenwich Village, he moved a distance of 1,100 feet, with the steeple, clock, pews, and all fixtures; no damage was done, not even so much as breaking a square of glass in either of the windows.

Mr. Brown informs us that, during the last 12 years, he has moved about 900 buildings, 400 of which had brick-fronts, and about 40 were entire brick buildings.

The following description of the operation Mr. Brown has handed us for insertion: it is from the fertile pen of Capt. Basil Hall, and is in every particular correct.

"Every one has heard of moving wooden houses; but the transportation of a brick dwelling is an exploit of a different nature. I shall describe simply what I saw, and then tell how the details were managed. In a street which required to be widened, there stood two houses much in the way, their front being twelve feet too far forward. These houses, therefore, must either have been taken down, or shifted back. Mr. Brown undertook to execute the less destructive process. They were both of brick, and built together, one being forty feet deep, and twenty-five feet front; the other thirty-two feet deep, and twenty-two feet front. They were of the same height, that is to say, twenty-two feet from the ground to the eaves, above which stood the roof and two large stacks of brick chimneys; the whole formed a solid block of building, having two rows of six windows each, along a front of forty-seven feet by twenty-two. This was actually moved in a compact body, without injury, twelve feet back from the street. I watched the progress of the preparations on the 25th of May with great interest; but unfortunately, just as the men were proceeding to the actual business of moving the screws, I was obliged to run off to keep an appointment with the Mayor and Corporation; and when I came back, three or four hours afterwards, the workmen had gone away, after moving the building thirty inches—which fact I ascertained by measurements of my own. On the next day, with equal perversity of fate, I was again called off to join a party going to New-Jersey; and on my return two days afterwards, I had the mortification to find the work completed. The houses were now exactly nine feet and a half from the position in which I had left them a few days before.

"It would be tedious, perhaps, were I to give a very minute description of the whole process; but it is so simple, that it may, with a little attention, be understood in a general way even by persons not much accustomed to such subjects, and may possibly be useful to those who are familiar with them.

"The first object is to place a set of strong timbers under the house, parallel to, and level with the street, at the distance of three feet apart, extending from end to end of the buildings, and projecting outwards several feet beyond the gable end walls. The extremities of these timbers are next made to rest upon blocks of wood, placed on the ground quite clear of the walls on the outside. Then by means of wedges driven between the timbers and the blocks, they are made to sustain a great part of the weight of the ends of the house. When this is done, the foundation of the end walls may be removed without danger, as they now rest exclusively on the timbers, the ends of which, as I have described, lie on solid blocks.

"I shall describe presently how the above operation of inserting the timbers is performed; but if for the present we suppose it done, and the house resting on a sort of frame-work, it is easy to conceive that a set of slides, or what are called in dock-yards, ways, on which ships are launched, may be placed transversely under these timbers, that is, at right angles to them, so as to occupy the very place where the foundations of the end walls once stood. It is necessary to interpose between these ways or fixed slides, and the aforesaid timbers, a set of cradles, similar in their purpose to the apparatus of the same name on which ships rest when launched, to which final process of ship-building, by-the-bye, this whole operation bears a close analogy.

These cradles are long smooth beams lying along the top of the ways, and in the same line with them; their under surfaces in contact with the ways, and the upper made to bear against the cross timbers which support the house. The object, at this stage of the business, is to bring the whole weight of the house upon these cradles, and, consequently, upon the ways which support them. If this be done, it follows that the ends of the timbers, formerly described as resting on the blocks, will no longer be supported at the same places. This change of the point of support is effected by driving in wedges between the timbers and the cradles; and it will readily be seen that these wedges have the two-fold effect of forcing the cradles down upon the ways, and at the same time of raising up the timbers which support the house, and consequently, in a very small degree, the house itself. The ends of the timbers now rest no longer on the blocks, which are removed, and the house, supported upon the cradles and the ways, is ready for being moved, as soon as the front and back walls have been taken away.

"Suppose all this done, there is nothing required but to apply screws, placed horizontally in the street, and butting against the cradles. On these being made to act simultaneously, the cradles, and consequently the frame which they support, together with the house on its back, move along.

"Such is a general account of the process. I shall now mention how the various difficulties, most of which I dare say will have suggested themselves in the foregoing account, are overcome in practice.

"The horizontal supporting timbers, already described as being placed parallel to the street, and nearly at the same level with it, are introduced one by one in this way. A hole is blocked out in each of the end walls, just above the ground, and large enough to admit a squared beam, say fifteen inches each way, of which the ends project beyond the gable walls about a couple of feet. A firm block of wood is then placed under each of these ends, and wedges being driven underneath, the beam is raised up, and made to bear against the upper parts of the holes. Thus the inserted timber completely supplies the office of the dislodged portions of the masonry. Another pair of holes is then made, and a second timber introduced, and so on till they are all inserted, and firmly wedged up. The distance at which these are placed must depend upon the weight of the wall. In the case I witnessed the houses were of brick, and the timber stood at the distance, I should think, of three feet apart. All this being done, the intermediate masonry, forming the foundation, may be gradually removed, and a clear space will be left under the supported walls for the reception of the ways.

"There are two more precautions to be attended to; these ways must all be coated with tallow, in a layer of at least half an inch thick, so that the wood of the cradles may never come in contact with them. Some device must also be adopted to prevent the whole affair, house and all, from sliding laterally off. This, Mr. Brown prevents, by cutting along the top of one of the ways a deep groove, into which is fitted a correspondent feather, as it is called, of the superincumbent cradle. This being made to work easy, and well greased, the direct motion is not retarded.

"I have said nothing all this time of the front and back walls; but it will easily be understood how these may be made to rest, like those at the ends, on timbers inserted under the house at right angles, to the first set. The whole of the supporting frame-work is tied so firmly together by bolts, that there is not the slightest bending or twisting of any part of the building.

"When at last the house has reached its destination, a new foundation is built, and the whole process being inverted, the timbers are withdrawn one by one; and such is the security of these operations, that no furniture is ever removed from the houses so transported. The inhabitants, I am told, move out and in as if nothing were going on. This, however, I did not see.*

"Mr. Brown was once employed to remove a house from the top to the bottom of a sloping ground; and, as no additional impulse from screws was here required, he resolved to ease the building down, as sailors call it, by means of a tackle. Unfortunately, about the middle of the operation, the strop of one of the blocks broke, and the operator, who was standing on the lower side of the building, was horrified by the apparition of the house under weigh, and smoking, by its

* We have been credibly informed that, during the operation of moving the house situate at 85 Maiden lane, the Mayor and Corporation, to the amount of 150 individuals, were in the house and partook of refreshments. Also, that, when the church before alluded to was moving, a clergyman delivered a discourse on science, as connected with religion, to a congregation of between 300 and 400 persons.—[Ed. Mec. Mag.]

friction, right down upon him. With that vigorous presence of mind, which is compounded of thorough knowledge, and a strong sense of the necessity of immediate action, and without which courage is often useless, he dashed a crow-bar, which he happened to have in his hand at the time, into a hole accidentally left in one of the ways, and leaping on one side watched the result. The momentum of the enormous moving body was so great that it fairly drove the iron bar, like a cutting instrument, for a considerable distance through the fibres of the timber. The main point, however, was gained, by the house being arrested in its progress down the hill; and the able engineer, like an officer who has shown himself fertile in resource, reaped more credit from the successful application of a remedy to an evil not anticipated, than if all had gone smoothly from the commencement."

Architecture.—Of the Orders of Architecture.

[Continued from page 226.]

The moderns have applied the term order to those architectural forms with which the Greeks composed the façades of their temples.

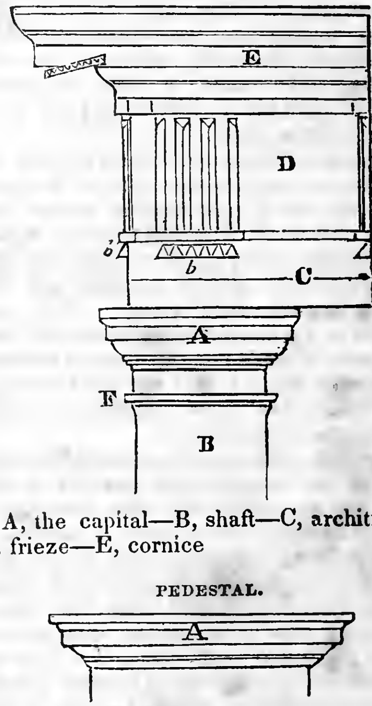
The principal members of an order are, 1st, a platform ; 2d, perpendicular supports ; and 3d, a lintelling or covering connecting the tops of these supports, and crowning the edifice.

The proportioning of these parts to the edifice and to each other, and at the same time adapting characteristical decorations, constitutes an order, *canon*, or rule.

The principal member of an order is the perpendicular support or *column*. The accompaniments being subservient to this leading feature, the bottom of the column is fixed either on a general artificial platform, or each upon a particular *plinth*, or both. The lower part of the column, which rests upon the square plinth, is sometimes encompassed with mouldings, which, in allusion to their position, are, in conjunction with the plinth, called the *base*.

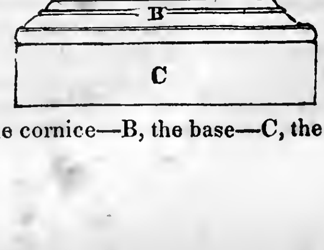
The top part of the column is also covered with a square plinth, with its sides straight or curved, and generally accompanied by circular mouldings or sculptured decorations upon the top part of the column, which is immediately underneath it ; this, taken together, is called the capital. The body of the column, which reaches between the base and capital, is termed the *shaft:* it is the frustrum of a cone, with sometimes a plain surface, but frequently having perpendicular flutings, either meeting in an edge or leaving a small plane space between them The lintelling or covering, which lies upon and connects the column, is termed the *Entablature*, and is sub-divided into three parts, named architrave, frieze, and cornice : the architrave consists of a mere lintel laid along the tops of the columns ; the frieze represents the ends of the cross beams resting upon the former, and having the spaces between filled up, having mouldings also fixed to conceal the horizontal joint, and divide it from the architrave ; and the upper member or cornice represents the projecting eaves of a Greek roof, showing the ends of the rafters.

These definitions will be easily understood by an inspection of the following figure :



A, the capital—B, shaft—C, architrave—D, frieze—E, cornice

PEDESTAL.



A, the cornice—B, the base—C, the plinth.

Importance of Education to the Practical Artizan.—An opinion both dangerous and pernicious to the mechanics of our country is prevailing among the majority of them. They imagine that literature, science, and general information, are unnecessary to them; and, that if they are acquainted with the commonest rules of arithmetic, reading, writing, and the trade to which they are called, they have all the acquirements their business demands. What have we to do, say they, with polite literature, with history, with the deeper branches of mathematics, the art of composition, eloquence, philosophy, &c.? They have nothing to do with our profession; we are to get our bread by the sweat of the brow; and we leave these branches of education to the ministers, the doctors, and the lawyers of the land.

Now, as long as sentiments like these prevail among mechanics, and the laboring classes of the community, so long they will be doomed to an intellectual and political slavery by the better educated class; so long they are doomed to be stripped of their power, and to be ridden by ambitious and designing men. When mechanics are really convinced that knowledge is power, and that the educated part of society give laws to the rest, they will wake up from their stupor and bestir themselves to get this power into their own hands. It is not the wealthy that rule in our legislative councils, in societies, in politics, in town meetings, and the every day concerns of life; it is not the aristocratic part of the community that have sway over the rest; but it is the educated, the active, the intelligent, who are the emperors and kings of our country: men of superior intelligence, who feel the power within them, and who exert it too to sway the rest.

As matters are now arranged in our country, the lawyers are the only men of whom we have to complain: they get into all the seats of power; give laws to the community, and then set about executing them; they are invested with both the legislative and executive power; the ability to make what laws they please, and the power to execute them as they please; they frame our laws, sit in our councils, are our judges, our justices, our presidents, our governors, our selectmen, our overseers; they creep into every seat of power from the lowest grade, till they reach the last goal of their ambition in the highest office of the gift of the people. The question now arises, from what source do they derive this immense power? Is it from the superior talents of the profession, from superior worth or superior wealth? We think not. This profession is undoubtedly the most intelligent portion of the community; and from this source may be traced all its influence over society in general. Divines and physicians are equally intelligent; but their avocations do not lead them to mingle so much in the business, the uproar, and the excitement of the world; and as they are less active, they consequently have less influence. Lawyers are not only the most intelligent part of the community who mingle in the affairs of the world, but they are far the most active; they exert themselves the most, in order to obtain the most influence.

Mechanics might have this same power,—yea, much more—for the feeling and the majority of the world are on their side; they have an interest too in propping up themselves, in building up their own professions; and now if they had the information to direct their energies aright, they would have within themselves an irresistible influence over the destinies of others. Mechanics do not hold that rank in society they might hold if they pleased, and which they are entitled to hold by the good they do to mankind. But make every mechanic feel the deep necessity of cultivating his mind, and drawing out its hidden treasures; make him feel that his mental power over society, as in fact it does, depends upon the quantity of information he acquires; let him believe that tact and skill, and a knowledge of the human character, are as necessary to him as a knowledge of his tools, and you give that mechanic his due proportion of influence with the world.

But we are stopped at once and told by the mechanic, he has no leisure to cultivate his intellect; his every day avocations demand all his attention and time. It is no such thing. Every man, even the busiest, the most industrious, has leisure enough, if he is disposed to spend that leisure as he ought, instead of whirling it away in trifling and idleness. Put these questions to yourself, and see if you have no leisure. How many evenings do you spend in idleness, in lounging, in useless talk, in beating the streets? How many more hours are devoted to sleep than are necessary for your health? How much of the Sabbath, aside from all hours due to devotion, is entirely wasted, when all might have been spent in reading valuable books? It is a fanciful idea that people have, when they say an education cannot be had without money and teachers.

The idea about the want of time is a mere phantom. Franklin found time in the midst of all his labors to dive into the hidden recesses of philosophy, and to explore an untrodden path of science. The great Frederick, with an empire at his direction, in the midst of war, and on the eve of battles which were to decide the fate of his kingdom, found time to revel in all the charms of philosophy and intellectual pleasures. Bonaparte, with all Europe at his disposal—with kings in his antichamber begging for vacant thrones—with thousands of men whose destinies were suspended on the brittle thread of arbitrary pleasure,—had time to converse with books. Let mechanics, then, make use of the hours at their disposal. They are the life-blood of the community; they can, if they please, hold in their hands the destinies of our republic; they are numerous, respectable, and powerful; they have only to be educated half as well as other professions, to form laws for the nation.

On the Progress of Knowledge. [From Dr. Arnott's Elements of Physics.]

It might be very interesting to show, in minute details, how the arts and civilization have progressed in accordance with the gradual increase of man's knowledge of the universe; but it would lead too far from the main subject. We deem it right, however, to make evident to the student the arousing truths, that the progress is not yet at an end; that it has been vastly more rapid in recent times than ever; and that it seems still to proceed with increasing celerity: and we know not where the Creator has fixed the limits of the change! Although there are thousands of years on the records of the world, our Bacon, who first taught the true way to investigate nature, lived but the other day. Newton followed him, and illustrated his precepts by the most sublime discoveries which one man has ever made. Harvey detected the circulation of the blood only two hundred years ago. Adam Smith, Dr. Black, and James Watt, were friends; and the last, whose steam-engines are now changing the relations of empires, may be said to be scarcely cold in his grave. John Hunter died not long ago; and Herschel's accounts of newly-discovered planets, and of the sublime structure of the heavens, are in the late numbers of our scientific journals: illustrious Britons these, who have left worthy successors treading in their steps. On the continent of Europe, during the same period, a corresponding constellation of genius has shone; and Laplace is now the bright star connecting the future with the past.*

But there is a change going on in the world, connected closely with the progress of science, yet distinct from it, and more important than half of the scientific discoveries: it is the *diffusion of existing knowledge* among the mass of mankind. Formerly knowledge was shut up in convents and universities, and in books written in the dead languages, or in books which, if in the living languages, were so abstruse and artificial, that only a few persons had access to their meaning; and thus, considering the human race as one great intellectual creature, a small fraction only of its intellect was allowed to come into contact with science, and therefore into activity; which fraction, moreover, was often only half exerted, because sufficient motive was wanting. The progress of science in those times was correspondingly slow, and the evils of general ignorance prevailed. Now, however, the strong barriers which confined the stores of wisdom have been thrown down, and a flood overspreads the earth; old establishments are adapting themselves to the spirit of the age; new establishments are arising; the inferior schools are introducing improved systems of instruction; and good books are rendering every man's fire-side a school. From all these causes there is growing up an *enlightened public opinion,* which quickens and directs the progress of every art and science, and, through the medium of a free press, although overlooked by many, is more rapidly becoming the governing influence in all the affairs of man. In Great Britain, partly perhaps as a consequence of its insular situation, which lessened among its inhabitants the dread of hostile invasion, and sooner formed them into a united and compact people, the progress of enlightened public opinion has been more decided than in any other state. The early consequences were more free political institutions; and these have gradually led to greater and greater improvements, until Britain is become an object of admiration among the nations. A colony of her children, imbued with her spirit, now occupies a magnificent territory in the new world of Columbus; and although it has been independent as yet for only half a century, it already counts more people than

* This was written in February, 1827, a few days before the news reached London of the death of this illustrious philosopher.

Spain, and will soon be second to no nation on earth. The example of the Anglo-Americans has aided in rendering their western hemisphere the cradle of other gigantic states, all free, and following, although at a distance, the like steps. In the still more recently discovered continent of Australasia, which is nearly as large as Europe, and is empty of men, colonization is spreading with a rapidity never before witnessed; and that beautiful and rich portion of the earth will also soon be covered with the descendants of free-born and enlightened Englishmen. From thence, still onward, they or their institutions will naturally spread over the vast archipelago of the Pacific Ocean, a track studded with islands of paradise. Such, then, is the extraordinary moment of revolution or transit, in which the world at present exists! And where, we may ask again, has the Creator predestined that the progress shall cease? Thus far at least we know, that he has made our hearts rejoice to see the world filling with happy human beings, and to observe that the increase of the sciences can make the same spot maintain thousands in comfort and god-like elevation of mind, where with ignorance even hundreds had found but a scanty and degrading supply.

The progress of knowledge, which has thus led from former barbarism to present civilization, has gone on by certain remarkable steps, which it is easy to point out; and which it is very useful to consider, because we thereby discover the nature of human knowledge, with the relations and importance of its different branches; and we obtain great facilities for studying science, and for quickening its farther progress.

The human mind, when originally directed to the infinity of objects in the university around it, must soon have discovered that there were resemblances among them; in other words, that the infinity was only a repetition of a certain number of kinds. Among animals, for instance, it would distinguish the sheep, the dog, the horse; among vegetables, the oak, the beech, the pine; among minerals, lime, flint, the metals, and so forth. And becoming aware that by studying an exemplar of each kind, its limited power of memory might acquire a tolerably correct knowledge of the whole, while this knowledge would enable the possessors more easily to obtain what was useful to them, and to avoid what was hurtful, the desire for such knowledge must have arisen with the first exercise of reason. Accordingly, the pursuit of it has been unremitting, and the labor of ages has at last nearly completed an arrangement of the constituent materials of the universe, under three great classes of Minerals, Vegetables, and Animals, commonly called the *three kingdoms of nature*, and of which the minute description is termed Natural History: and museums of natural history have been formed, which contain a specimen of almost every object included in these classes, so that, now, a student within the limits of an ordinary garden, may be said to be able to examine the whole of the universe.

Books.—Nothing in this world, except the Christian religion, is probably so much abused as books. To say nothing of the pollution and death spread far and wide by books made and circulated by bad men, those made and used with the best designs and intentions very often act as so many opaque substances, placed directly between the mind and the objects they attempt to present to it. They wholly intercept the light reflected directly from *things* themselves, for the miserable substitutes of unmeaning *signs* of things. A better example to illustrate this position is perhaps not necessary, than the very first instance in which children are called away from things to the scene of their *education*, under the dreadful *abuse* of that term in its frequent, perhaps common application. We refer to the time when children are taken from their homes, from the nursery, the kitchen, the gardens, the yards, and the fields, where they are surrounded with the beautiful and useful objects of nature and art, which give full scope and exercise to their eager and active minds and susceptible hearts, and are put into that dismal place of confinement, the school room, with no other employment, but to 'say A and B, and sit on a bench.' We may bring the *unlettered* savage to illustrate the same position; for it is a fact well known to those acquainted with these specimens of nature, that they have a better knowledge of their minerals, their vegetables, their animals, and their geography, than the boasting people of New-England have of theirs. Almost any native of the forest will delineate, with great exactness, the boundaries, the rivers and brooks, the mountains, hills, and forests, of the country which is the scene of his travels and his interests, and the field of his possessions and his rights.

On the other hand, no class of men are so *unfortunately* ignorant as those whose *educa-*

tion has been restricted to the school room, the college, and the library. Each exerts to its full extent the *opaque* property of planks, slabs, bricks, and pasteboard, to shut out from the mind the light and the knowledge of things and of *common sense*. No class of men in the community are more useless, (we wish they were merely useless,) than those thus educated. As politicians they are visionary and utopian, and yet ambitious and overbearing, and, of course, dangerous; as lawyers they are insinuating, indolent, and yet disturbers of the peace of neighborhoods and families; as physicians, they are rash, injudicious, and frequently murderous; as clergymen, they are dogmatical, pretending, and often tyrannical over the common sense and consciences of men; and as members of the great family of man, they are to a great extent so many blots in the cheerful and harmonious creation of God.

If we wished to *educate* a child into a being perfectly useless to the world or to himself, we would put him at an early age into the schools of a city, and carry him through the several grades, occupying eight or ten years, and then send him to a college, either in the city or the one the nearest to it, and we should be almost sure of gaining our point. He would be able to repeat all the signs which the Greeks and Romans used for ideas, and use them for shutting all ideas out of his own mind. He would be likely to collect the syllogysms, the dogmas and the mysticisms of all the institutions which have diffused darkness through other ages and countries, and completely envelope himself, and perhaps many around him, in the same darkness. He might repeat, in numberless and beautiful technicalities, the laws and the operations of matter and of mind,—aye, and the arts, too,—without knowing whether he was indebted for his bread to the tiller of the field, or the worker in metals. He might still be at a loss whether to put the horse before the cart, or cart before the horse. We have instances thick around us of those whose *book education* is complete, and more than complete, (the stick is so much straightened as to be made crooked, the post is *made* more than perpendicular,) who are yet as ignorant of men and things, and of course of the proper modes of promoting or sustaining their various relations and interests, as if they had been educated by and for the inhabitants of another planet —as if they were on their first visit to our globe, from the Moon or Venus.

We do not intend, by these remarks, that books ought to be used for bonfires, or that they ought to be thrown into disuse; we mean that they, like christianity, ought to be properly used, not abused; we mean that as christianity ought to promote love, not hatred, so books ought to promote knowledge, not ignorance—to enlighten, not obscure the mind—to lead their pupils to observe, and to study men and things, not to shut them away from them—to cultivate common sense, not to destroy it—to aid in cultivating the germ of immortality, implanted in every mind and heart, into a tree which shall spread its branches, and scatter the fruits of intelligence and christianity through boundless space and endless ages.

Mind and Heart.—The laws and powers of mind and heart, and their influence and action upon each other, present more that is curious, grand, and important, than any other subject beneath the sun. The mind and heart, or the intellect and affections, each possesses various powers, and the powers of each are essential to the other. Feeling, or affection without intellect, could not raise a being above the brutes; and mere intellect without feeling must leave a being without moral character. The possession of both, and the disciplined or well-regulated action of one upon the other, constitute true excellence of character. The intellect discovers truth, and the feelings urge the being to pursue it. The intellect distinguishes between right and wrong, and the affections lead to the pursuit of the one and the avoiding of the other; or where the intellect is entirely under the control of the passions or feelings, the individuals may perceive the right, but pursue the wrong. The intellect of the drunkard lays fully before him the evils and ruin he is bringing upon himself and his family, by pursuing his cups, and yet he may be so entirely under the control of his passions or appetites, as to suffer his intellect to have no voice in directing his steps, but in spite of her intreaties he rushes headlong to destruction, and brings poverty, wretchedness, and disgrace, upon a wife and children, for whom he would before have been ready to sacrifice his life.

It is evident, then, that a man wholly under the control of feeling, or passion, of any kind, may become a brute or a monster, a sot, or debauchee, a highway robber, a murderer, a public butcher of his own species.

On the other hand, if intellect is the only power called into exercise, while it may lead to much abstract truth, it will do little or nothing to embody that truth in living actions—to apply it to its uses. It may be making constant progress in unfolding the laws of the physical, the intellectual, and even the moral world, without applying one of those laws for the benefit of his fellow men. Though such a being may be a philosopher, he is a cold philosopher—an intellectual miser; hording up materials which neither himself nor any one else can use, except in the selfish and miserly reflection, that they are *in* his possession.

But when all the powers of the intellect, and all the feelings of the heart, are brought into a vigorous and healthy operation, the one exerting its proper influence upon the other, they indeed present a specimen of "the noblest work of God"—a being worthy of God and himself—a character which the cold philosopher must approve and admire, though he cannot imitate; which the abandoned debauchee must respect, though he may hate. Such a character is a *Christian philosopher*.

Facts in Physics.—Gold beaters, by hammering, reduce gold to leaves so thin that 282,000 must be laid on each other to produce the thickness of an inch. They are so thin, that, if formed into a book, 1500 would occupy the space of a single leaf of common paper.

A grain of blue vitriol, or carmine, will tinge a gallon of water, so that in every drop the color may be perceived; and a grain of musk will scent a room for twenty years.

A stone, which on land requires the strength of two men to lift, may be lifted in water by one man.

A ship draws less water by one thirty-fifth in the heavy salt water than in the water of a river, and a man may support himself more easily in the sea than in a river.

An immense weight may be raised a short distance by first tightening a dry rope between it and a support, and then wetting the rope. The moisture imbibed into the rope by capillary attraction causes it to become shorter.

A rod of iron which, when cold, will pass through a certain opening, when heated expands, and becomes too thick to pass. Thus the tire or rim of a coach wheel when heated goes on loosely, and when cooled it binds the wheel most tightly.

One pint of water converted into steam fills a space of nearly 2000 pints, and raises the piston of a steam engine with a force of many thousand pounds. It may afterwards be condensed and re-appear as a pint of water.

A cubic inch of lead is forty times heavier than the same bulk of cork. Mercury is nearly fourteen times heavier than the same bulk of water.

Sound travels in water about four times quicker, and in solids from ten to twenty times quicker than in air.

Excellence not limited by Station.—There is not a more common error of self-deception than a habit of considering our stations in life so ill-suited to our powers as to be unworthy of calling out a full and proper exercise of our virtues and talents.

As society is constituted there cannot be *many* employments which demand very brilliant talents, or great delicacy of taste, for their proper discharge. The great bulk of society is composed of plain, plodding men, who move "right onwards" to the sober duties of their calling. At the same time the universal good demands that those whom Nature has greatly endowed should be called from the ordinary track to take up higher and more ennobling duties. England, happily for us, is full of bright examples of the greatest men raised from the meanest situations; and the education which England is now beginning to bestow upon her children will multiply these examples. But a partial and incomplete diffusion of knowledge will also multiply the victims of that evil principle which postpones the discharge of present and immediate duties, for the anticipations of some destiny above the labors of a handicraftsman, or the calculations of a shop-keeper. Years and experience, which afford us the opportunity of comparing our own powers with those of others, will, it is true, correct the inconsistent expectations which arise from a want of capacity to set the right value on ourselves. But the wisdom thus gained may come too late. The object of desire may be found decidedly unattainable, and existence is then wasted in a sluggish contempt of present duties; the spirit is broken; the temper is soured; habits of misanthropy and personal neglect creep on; and life eventually becomes a tedious and miserable pilgrimage of never-satisfied desires. Youth, however, is happily not without its guide, if it will take a warning

from example. Of the highly gifted men whose abandonment of their humble calling has been the apparent beginning of a distinguished career, we do not recollect an instance of one who did not pursue that humble calling with credit and success until the occasion presented itself for exhibiting those superior powers which Nature occasionally bestows. Benjamin Franklin was as valuable to his master, as a printer's apprentice, as he was to his country as a statesman and a negotiator, or to the world as a philosopher. Had he not been so, indeed, it may be doubted whether he ever would have taken his rank among the first statesmen and philosophers of his time. One of the great secrets of advancing in life is to be ready to take advantage of those opportunities which, if a man really possesses superior abilities, are sure to present themselves some time or other. As the poet expresses it, "There is a *tide* in the affairs of men,"—an ebbing and flowing of the unstable element on which they are born,—and if this be only "taken at the flood," the "full sea" is gained on which "the voyage of their life" may be made with ease and the prospect of a happy issue.

But we should remember, that, for those who are not *ready* to embark at the moment when their tide is at its flood, that tide may never serve again; and nothing is more likely to be a hindrance at such a moment than the distress which is certain to follow a neglect of our ordinary business.

Geometrical Diagrams.—The sheet of geometrical diagrams published in Boston, and recently improved, many thousands of which are in use in families and schools, have the following advantages:

1. They give children at first correct names of things, and thus avoid the necessity of their *unlearning*. 2. They furnish an interesting and continued employment to children. 3. They give a useful exercise to their hands, eyes, judgment, and taste. 4. They make children happy, by a useful as well as agreeable exercise of their various faculties. 5. They relieve mothers and teachers from the uneasiness and consequent teazing of children. 6. They prevent mischief done by children, when left to seek their own employment, such as trying experiments on crockery, tables, chairs, and other furniture. 7. They answer instead of the "*birch*" to keep children orderly. 8. They learn children to *think*, to *compare*, to *discriminate*, instead of looking *vaguely* and carelessly at things. 9. They interest children, in the family and school apparatus which they accompany, in arithmetic, geography, and in all their studies, especially writing, whether at school or at home. 10. They furnish, more than any thing else, the elements of the whole circle of the sciences and the arts, such as Natural Philosophy, Astronomy, Chemistry, Mineralogy, Surveying, Navigation, Drawing, Measuring surfaces and solids, such as boards, cloth, land, wood, timber, walls, casks, cisterns, bins, &c. &c. They are more economical than any thing else for which 12 1-2 cents can be paid.

Boundlessness of the Creation.—About the time of the invention of the telescope, another instrument was formed, which laid open a scene no less wonderful, and rewarded the inquisitive spirit of man. This was the microscope. The one led me to see a system in every star; the other leads me to see a world in every atom. The one taught me that this mighty globe, with the whole burden of its people and its countries, is but a grain of sand on the high field of immensity; the other teaches me that every grain of sand may harbor within it the tribes and families of a busy population. The one told me of the insignificancy of the world I tread upon. The other redeems it from all insignificancy; for it tells me that in the leaves of every forest, and in the flowers of every garden, and in the waters of every rivulet, there are worlds teeming with life, and numberless are the glories of the firmament. The one has suggested to me, that beyond and above all that is visible to man, there may be fields of creation which sweep immeasurably along, and carry the impress of the Almighty's hand to the remotest scenes of the universe; the other suggests to me, that within and beyond all that minuteness which the aided eye of man has been able to explore, there may be a region of invisibles; and that, could we draw aside the mysterious curtain which shrouds it from our senses, we might see a theatre of as many wonders as astronomers have unfolded, a universe within the compass of a point so small as to elude all the powers of the microscope, but where the wonder-working God finds room for all his attributes, where he can raise another mechanism of worlds, and fill and animate them all with the evidence of his glory.—[Chalmers.]

Fire Proof Cement.—The French cement for the roofs of houses, to preserve the wood and protect it from fire, is made in the following manner:

Take as much lime as is usual in making a pot full of whitewash, and let it be mixed in a pail full of water; in this put two and a half pounds of brown sugar, and three pounds of fine salt; mix them well together, and the cement is completed. A little lampblack, yellow ochre, or other coloring commodity, may be introduced to change the color of the cement, to please the fancy of those who use it. It has been used with great success, and been recommended particularly as a protection against fire. Small sparks of fire, that frequently lodge on the roofs of houses, are prevented by this cement from burning the shingles. So cheap and valuable a precaution against the destructive element ought not to pass untried. Those who wish to be better satisfied of its utility can easily make the experiment, by using on a small temporary building—or it may be tried by shingles put together for the purpose, and then exposed to the fire.

Disappointments of the Authors of Important Improvements.—Almost every one who has rendered a great service to mankind, by striking out inventions, whose objects are misconceived or imperfectly misunderstood by the world, has had to complain of the neglect or coldness of his own generation. Even his best friends are apt to suspect his motives and undervalue his labors. The real recompense in such circumstances, as in all others, is the consciousness of doing one's duty. Fulton, the inventor of the steamboat in North America, which, in a few years, has produced such an astonishing change in that vast country, by connecting together its most distant states, sustained the mortification of not being comprehended by his countrymen. He was, therefore, treated as an idle projector, whose schemes would be useless to the world and ruinous to himself. At a discourse delivered at the Mechanics' Institute, Boston, in 1829, by Judge Story, the feelings of Fulton, upon his first public experiment, are thus related:

"I myself have heard the illustrious inventor of the steamboat relate, in an animated and affecting manner, the history of his labors and discouragements. When, said he, I was building my first steamboat at New-York, the project was viewed by the public either with indifference or with contempt, as a visionary scheme. My friends, indeed, were civil, but they were shy. They listened with patience to my explanations, but with a settled cast of incredulity on their countenances. I felt the full force of the lamentation of the poet,

> 'Truths would ye teach, to save a sinking land,—
> All shun, none aid you, and few understand.'

As I had occasion to pass daily to and from the building yard, while my boat was in progress, I have often loitered unknown near the idle groups of strangers, gathering in little circles, and hearing various inquiries as to the object of this new vehicle. The language was uniformly that of scorn, or sneer, or ridicule. The loud laugh often rose at my expense: the dry jest; the wise calculation of losses and expenditures; the dull but endless repetition of the Fulton Folly. Never did a single encouraging remark, a bright hope, or a warm wish, cross my path. Silence itself was but politeness, veiling its doubts, or hiding its reproaches. At length the day arrived when the experiment was to be put into operation. To me it was a most trying and interesting occasion. I invited my friends to go on board to witness the first successful trip. Many of them did me the favor to attend, as a matter of personal respect; but it was manifest that they did it with reluctance, fearing to be the partners of my mortification, and not of my triumph. I was well aware, that, in my case, there were many reasons to doubt of my own success. The machinery was new and ill made; many parts of it were constructed by mechanics unaccustomed to such work; and unexpected difficulties might reasonably be presumed to present themselves from other causes. The moment arrived in which the word was to be given for the vessel to move. My friends were in groups on the deck. There was anxiety mixed with fear among them. They were silent, and sad, and weary. I read in their looks nothing but disaster, and almost repented of my efforts. The signal was given, and the boat moved on a short distance, and then stopped, and became immovable. To the silence of the preceding moment now succeeded murmurs of discontent, and agitations, and whispers, and shrugs. I could hear distinctly repeated, 'I told you it would be so, it is a foolish scheme; I wish we were well out of it.' I elevated myself upon a platform, and addressed the assembly. I stated that I knew not what was the matter; but if they would be quiet, and indulge me for half an hour,

I would either go on or abandon the voyage for that time. This short respite was conceded without objection. I went below, examined the machinery, and discovered that the cause was a slight mal-adjustment of some of the work. In a short period it was obviated. The boat was again put in motion. She continued to move on. All were still incredulous. None seemed willing to trust the evidence of their senses. We left the fair city of New-York; we passed through the romantic and ever varying scenery of the Highlands; we descried the clustering houses of Albany; we reached its shores; and then, even then, when all seemed achieved, I was the victim of disappointment. Imagination superceded the influence of fact. It was then doubted if it could be done again; or if done, it was doubted if it could be made of any great value."

Sinking Wells.—Bishop Heber mentions a curious way of sinking wells in some parts of Asia. When the ground is sandy, a cylindrical tower of brick or stone work is made of the intended size of the well. This is suffered to remain until the masonry becomes indurated, and then it is gradually undermined until it is sunk even with the surface of the ground. If the well is not sufficiently deep, they add more masonry, and again undermine.

Canals.—The annexed account of an interesting experiment, with reference to accelerating the movement of boats on canals, will be found worthy the attention of those who take a direct interest in the concerns of Internal Improvement. In canals, as used in this country, speed may perhaps be of less consequence than regularity in transmission of freight, though certain it is, that, in almost all transactions, time is money:

Accelerated Movement upon Canals.—In England, recently, a trial was made upon the Paddington Canal, of the new canal-boat. The object of the trial was to show that a boat built in a different form, and constructed of other materials than the ordinary canal-boat, might, by using superior horses, be drawn along the water at the rate of ten miles or more in an hour, instead of two miles an hour, the pace of the boats now in use. The day was remarkably fine. The portion of the canal more particularly appropriated to the experiment was from the third to the seventh mile from Paddington. The boat was constructed of sheet-iron, rivetted hot, It was 70 feet long, by 5½ feet wide, and painted green and white. The boat was provided with an awning made of white twilled cotton cloth, which had been rendered semi-transparent with oil. The awning was so set up that the top was extended over light wooden arches, which rested upon a thin upright frame of rod iron; and the sides, in the form of curtains, were made to slide at pleasure upon paralleled rods placed at the upper and lower ends of the curtains. The rudder was of a single sheet of iron, of about a yard in length, and it was moved by a tiller made of about two yards of stout rod iron. Two steady hunting horses, each mounted by a lad, and the two harnessed to a towing rope of about 150 feet in length, constituted the moving power. The number of persons on board the boat was 48, including the crew, the gentlemen making the experiment, some of the principal members of the Grand Junction Company, and the visiters, amongst whom were Mr. Telford, Mr. Babbage, Captain Basil Hall, Mr. Hellyer, and Mr. Gill; a lady also made one of the party on this interesting occasion. Certain distances were measured on the canal bank, and marks set up at the ends of them. At each of these places, also, a man was stationed with a guaged rod in his hand, which he so held, as that, upon the boat's passing, he might instantly read off the height of the wave caused by the disturbance of the water. When all things were ready on the shore, and the party had embarked, the boat was put in motion. The speed from one station to another, taken by seconds' watches, showed, for some time, a progress at the rate of thirteen miles an hour. The horses, however, soon began to tire, and the speed fell to eleven, and ultimately, in returning for the third time, to ten and a quarter miles in the hour.

The experiment, as far as it goes was attended with complete success. The motion is the easiest imaginable. The boat glides along the water so smoothly and noiselessly, that its progress is all but imperceptible to those on board whose attention is not extended to external objects. A relay of horses will be required at the end of every four or five miles. The banks of the canal will have to be edged for nine or ten inches above the ordinary level of the water with hard materials, and the towing-path to be slightly sloped outwards. Improvements, no doubt, will also be made to facilitate the passing of locks, and in the mode of attaching the horses to the boat, so that the animals may exert their

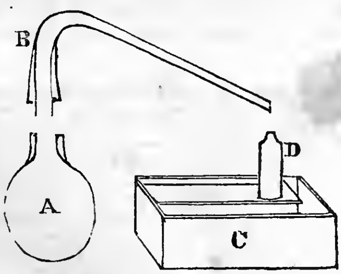
power upon the boat disembarrassed of the awkwardness of the direction in which, under the present form of towing, they are made to put forth their strength.—[London Albion.]

SCIENCE PRECEDING ART.—When the principles of any science are become common to all the world, these principles lead to inventions, nearly, if not altogether similar, by different persons having no communication with each other. A remarkable instance of this is given by Judge Story, in his address to the Boston Mechanics' Institute:

"A beautiful improvement has been made in the double-speeder of the cotton spinning machine by one of our ingenious countrymen. The originality of the invention was established by the most satisfactory evidence. The defendant, however, called an Englishman as a witness, who had been a short time in the country, and who testified most explicitly to the existence of a like invention in the improved machinery in England. Against such positive proof there was much difficulty in proceeding. The testimony, though doubted, could not be discredited; and the trial was postponed to another term, for the purpose of procuring evidence to rebut it. An agent was despatched to England for this and other objects; and, upon his return, the plaintiff was content to become nonsuited. There was no doubt that the invention here was without any suspicion of its existence elsewhere; but the genius of each country, almost at the same moment, accomplished, independently, the same achievement."

History of Chemistry. [Continued from No. 5, page 229.]

OF OXYGEN GAS.—Oxygen gas may be obtained by the following process:



Procure an iron bottle of the shape A, and capable of holding rather more than an English pint. To the mouth of this bottle an iron tube bent like B is to be fitted by grinding. A gun-barrel deprived of its butt end answers the purpose very well. Into the bottle put any quantity of the black oxide of manganese* in powder; fix the iron tube into its mouth, and the joining must be air tight; then put the bottle into a common fire, and surround it on all sides with burning coals. The extremity of the tube must be plunged under the surface of the water with which the vessel C is filled.

This vessel may be of wood or japanned tin plate. It has a wooden shelf running along two of its sides, about three inches below the top, and an inch under the surface of the water. In one part of this shelf there is a slit, into which the extremity of the iron tube plunges. The heat of the fire expels the greatest part of the air contained in the bottle. It may be perceived bubbling up through the water of the vessel C from the extremity of the iron tube. At first the air bubbles come over in torrents; but after having continued for some time, they cease altogether.

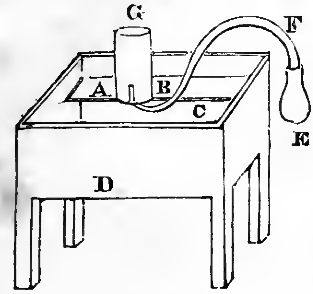
Meanwhile the bottle is becoming gradually hotter. When it is obscurely red the air bubbles make their appearance again, and become more abundant as the heat increases. This is the signal for placing the glass jar D, open at the lower extremity, previously filled with water, so as to be exactly over the open end of the gun-barrel. The air bubbles ascend to the top of the glass jar D, and gradually displace all the water. The glass jar D then appears to be empty, but is in fact filled with air. It may be removed in the following manner: Slide it away a little from the gun-barrel, and then dipping any flat dish into the water below it, raise it on the dish and bear it away. The dish must be allowed to retain a quantity of water in it, to prevent the air from escaping. Another jar may then be filled with air in the same manner; and this process may be continued either till the manganese ceases to give out air, or till as many jars-full have been obtained as are required.† This method of obtaining and confining air was first invented by Dr. Mayou, and afterwards much

* This substance shall be afterwards described. It is now very well known in Britain, as it is in common use with bleachers, and several other manufacturers, from whom it may be easily procured.

† For a more exact description of this and similar apparatus, the reader is referred to Lavoisier's *Elements of Chemistry*, and Priestley *on Airs*; and above all, to Mr. Watt's description of a *pneumatic apparatus*, in Beddoe's *Considerations on Factitious Airs.*

improved by Dr. Hales. All the air obtained by this or any other process, or, to speak more properly, all the airs differing in their properties from the air of the atmosphere, have, in order to distinguish them from it, been called gasses; and this name we shall afterwards employ.*

Oxygen gas may also be obtained in a different manner, thus: Let D represent a



wooden trough, the inside of which is lined with lead or tinned copper; and let C be a cavity in the trough, which ought to be a foot deep. The trough is to be filled with water at least an inch above the shelf A B, which runs along the inside of it, about three inches from the top. In the body of the trough, which may be called the cistern, the jars destined to hold gas are to be filled with water, and then to be lifted, and placed inverted upon the shelf at B.

This trough, which was invented by Dr. Priestley, has been called by the French chemists the *pneumato-chemical*, or simply *pneumatic* apparatus, and is extremely useful in all experiments in which gasses are concerned. Into the glass vessel E put a quantity of black oxide of manganese in powder, and pour over it as much of that liquid which in commerce is called *oil of vitriol*, and in chemistry *sulphuric acid*, as is sufficient to form the whole into a thin paste; then insert into the mouth of the vessel the glass tube F, so closely that no air can escape except through the tube. This may be done either by grinding, or by covering the joining with a little glazier's putty, and then laying over it slips of bladder or linen dipped in glue, or in a mixture of the white of eggs and quick-lime. The whole must be made fast with cord.

The end of the tube F is then to be plunged into the pneumatic apparatus D, and the jar G, previously filled with water, to be placed over it on the shelf. The whole apparatus being fixed in that situation, the glass vessel E is to be heated by means of a lamp or candle. A quantity of oxygen gas rushes along the tube F, and fills the jar G. As soon as the jar is filled, it may be slid to another part of the shelf, and other 'ars substituted in its place, till as much gas has been obtained as is wanted. The last of these methods of obtaining oxygen gas was discovered by Scheele, the first by Dr. Priestley.

The gas obtained by the above processes was discovered by Dr. Priestley on the 1st of August, 1774, and called by him *dephlogisticated air*. Mr. Scheele, of Sweden, discovered it before 1777, without any previous knowledge of what Dr. Priestley had done: he gave it the name of *empyreal air*.* Condorcet gave it first the name of *vital air;* and Mr. Lavoisier afterwards called it *oxygen gas:* a name which is now generally received, and which we shall adopt.

1. Oxygen gas is colorless, and invisible like common air. Like it, too, it is elastic, and capable of indefinite expansion and compression.

2. If a lighted taper be let down into a phial filled with oxygen gas, it burns with such splendor that the eye can scarcely bear the glare of light, and at the same time produces a much greater heat than when burning in common air. It is well known that a candle put into a well closed jar, filled with common air, is extinguished in a few seconds. This is also the case with a candle in oxygen gas; but it burns much longer in an equal quantity of that gas than of common air.

It has been ascertained by experiment, which shall be afterwards related, that atmospherical air contains 22 parts in the hundred (in bulk) of oxygen gas; and that no sub-

* The word gas was first introduced into Chemistry by Van Helmont. He seems to have intended to denote by it every thing which is driven off from bodies in a state of vapors by heat.

* This process, by which the joinings of vessels are made air tight, is called *luting*, and the substances used for that purpose are called *lutes*. The lute most commonly used by chemists, when the vessels are exposed to heat, is fat lute, made by beating together, in a mortar, fine clay and boiled linseed oil. Bees-wax, melted with about one eighth part of turpentine, answers very well, when the vessels are not exposed to heat. The accuracy of chemical experiments depends almost entirely in many cases upon securing the joinings properly with luting. The operation is always tedious; and some practice is necessary before one can succeed in luting accurately. Some very good directions are given by Lavoisier. See his *Elements*, Part iii. chap. 7. In many cases luting may be avoided altogether, by using glass vessels properly fitted to each other by grinding them with emery

stance will burn in common air previously deprived of all the oxygen gas which it contains. But combustibles burn with great splendor in oxygen gas, or in other gasses to which oxygen has been added. Oxygen gas, then, is absolutely necessary for combustion.

It has been proved also, by many experiments, that no breathing animal can live for a moment in any air or gas which does not contain oxygen gas mixed with it. Oxygen gas, then, is absolutely necessary for respiration.

When substances are burned in oxygen gas, or in any other gas containing oxygen, if the air be examined after the combustion, we shall find that a great part of the oxygen has disappeared. If charcoal, for instance, be burned in oxygen gas, there will be found, instead of part of the oxygen, another very different gas, known by the name of carbonic acid gas. Exactly the same thing takes place when air is respired by animals; part of the oxygen gas disappears, and its place is occupied by substances possessed of very different properties. Oxygen gas then undergoes some change during combustion, as well as the bodies which have been burned; and the same observation applies also to respiration.

Oxygen gas is somewhat heavier than common air. If the specific gravity of common air be reckoned 1·000, that of oxygen gas, as determined by Mr. Kirwan, is 1·103. With this result the statement of Lavoisier agrees exactly. But Mr. Davy found it a little heavier; and Fourcroy, Vauquelin, and Seguin, found it a little lighter. Its specific gravity, according to Mr. Davy's experiments, is 1·127*: according to the French chemists, 1·087.

At the temperature of 60 degrees, and when the barometer stands at 30 inches, 100 cubic inches of common air weigh very nearly 31 grains; and 100 cubic inches of oxygen gas, at the same temperature and pressure, weigh, according to Mr. Kirwan and Lavoisier, 34 grains; according to Sir H. Davy, 34·74 grains.

Oxygen gas is not sensibly absorbed by water, except under great pressure; but by forcing it into a bottle of water by strong pressure, it may be made to absorb half its bulk of that gas, and to retain it in solution. Water thus impregnated does not sensibly differ from common water, either in taste or smell. It has been found a valuable remedy in several diseases.

Oxygen is capable of combining with a great number of bodies, and of forming compounds possessed of very different qualities.

As the combination of substances with each other is of the utmost importance in chemistry, we shall here make a few observations on that subject before we proceed to the consideration of the nature and properties of *Hydrogen Gas*.

When common salt is thrown into a vessel of pure water, it melts, and very soon spreads itself through the whole of the liquid, as any one may convince himself by the taste. In this case the salt combines with the water, and cannot afterwards be separated by filtration, or any other mechanical means. It may, however, be done by a very simple process; for if a quantity of the spirit of wine be poured into the solution, the salt will fall slowly to the bottom of the vessel in the state of a very fine powder.

It was long ago asked, why does the salt dissolve in water? and also, why does it fall to the bottom on pouring in spirit of wine? These questions were first answered by Sir Isaac Newton.

There is a certain attraction between the particles of common salt and those of water, which causes them to unite together whenever they are presented to one another. There is also an attraction between the particles of water and spirit of wine, which equally disposes them to unite, and this attraction is greater than that between the water and the salt; the water, therefore, leaves the salt to unite with the spirit of wine; and the salt being now unsupported, falls down by its weight to the bottom of the vessel. This power, which disposes the particles of different bodies to unite, was called by Newton *attraction*, by Bergman *elective attraction*, and by many of the German and French chemists *affinity*; and this last term is now employed in preference to others, because they are rather general. All substances which are capable of combining together, are said to have an *affinity* for each other; on the contrary, those substances which do not unite are said to have no affinity for each other. Thus, oil and water are said to have no affinity for one another.

It appears, from the instance of the common salt and spirit of wine, that substances

* Mr. Davy's oxygen gas was procured from oxide of manganese. It is possible that it contained a little *carbonic acid gas*. The tests used would not have excluded that body. This would explain its greater specific gravity.

differ considerably in the degree of their affinity from other substances, for the spirit of wine displaced the salt, and united with the water. Spirit of wine has, therefore, a stronger affinity for water than common salt has.

From facts of this kind tables of affinity have been formed and arranged in a very peculiar manner. The substance whose affinities are to be represented, is placed at the top of a column; and beneath it the bodies for which it has an attraction, placing those nearest to it which it attracts most strongly. Thus, in exhibiting the affinities of muriatic acid, the bodies for which it has an affinity would be placed thus:

MURIATIC ACID.

—

Barytes,
Potash,
Soda, &c.

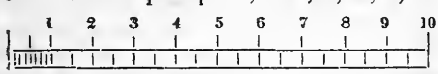
This method is now universally adopted, and has contributed very much to the rapid progress of chemistry.

We shall treat this subject fully in a future number: we introduce it here merely to give the student of chemistry some idea of what is meant by bodies combining together, as the expression will frequently occur even in treating of simple bodies.

Gunter's Scale. By G. A. Seares. [From the London Mechanics' Magazine.]

Mr. Editor,—The great difficulty in the use of Gunter seems to be in taking from the scale three or more figures; now, in order to thoroughly understand how this is performed, I will first show how, from any plane scale of *equal parts*, decimally devided, we are able to do this.

Let a line, as represented below, be divided into ten equal parts, as 1, 2, 3, 4, &c.



and let one part be supposed divided again into ten equal parts (and all the rest similarly divided), it is plain that each large division will be a unit, or the tenth part of the whole line, and each small division the tenth of a unit; now, if the scale is long enough, each of these *small* divisions may be divided again into ten equal parts, which parts will be the *tenth of the tenth* of a unit, or the hundredth part of a unit.

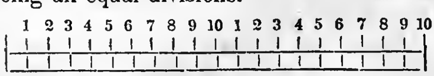
Now, if, instead of calling the whole line *ten*, we call it an *hundred*, the large divisions will then be *tens*, the small divisions *units*, and the subdivisions (if the scale is long enough to admit it) *tenths of units;* in the same manner, if the whole line is called a *thousand*, the large divisions will be each a *hundred*, the small divisions *tens*, and the subdivisions *units*.

It is thus plain that the same scale will answer for either one *unit* with three decimals, one *ten* with two decimals, one *hundred* with one decimal, or one *thousand* without any decimal: thus you may take off from the scale (if long enough) all numbers from ·0001 to 1000.

Example. Suppose it was required to take an extent from the scale, with your compasses, answering to 976.

Here your highest denomination is hundreds; therefore the large divisions stand for *hundreds*, the small ones for *tens*, and the subdivisions *units*. Therefore, setting one leg at the beginning of your scale, open your compasses equal to nine of the large divisions, seven of the small, and eight of the subdivisions, that is 976, and the same extent will answer to, or express, 97·6, or 9·76, or ·976. It may be here observed that, in the figure drawn above, the small divisions are not drawn throughout the whole length of the scale, as it would cause confusion, and the subdivisions are not marked, as in such a small scale it would have been impossible; but they may be conceived to be drawn and estimated with ease in a scale sufficiently extended.

We will now show how, from this scale of equal parts, we may *add* or *subtract* any number from another, and also find an arithmetical mean between any two numbers; in order to do which, it will be convenient to lay down, on another similar scale, the above line, as in the annexed figure (but too small to show the small divisions or subdivisions), which is analogous to Gunter's line of numbers, which is two scales marked from one to ten, but not of equal divisions; whereas this is marked from one to ten, and repeated, being all equal divisions.



Let us illustrate this by an example in each case.

Example 1. Let it be required to add 749 to 856.

Here we have the greatest denomination *hundreds;* therefore the great divisions are hundreds, the small ones tens, and the sub-

divisions units; now find, in the left hand scale, 8, which is 800, and 5 in the small divisions, which is five tens, or 50; and between that and the next small division, take six of the subdivisions, which is six units, expressing 856. Now, this is the point on which to place one leg of the compasses; then, in the same manner, open the compasses to the extent 749, and with that extent, with one leg at the point 856 (as found), the other leg will reach to 6 in the right hand scale, (which, as we make every large division 100, will be 1000 + 600, or 1600,) and not quite to the first small division, which is 0; and in the subdivisions the leg of the compasses will coincide on that which is the fifth subdivision from the 6; thus we have 1000 + 600 + 0 + 5, that is, 1605, the correct answer. And thus we may add any two numbers whose sum shall not exceed 2000; and if a third scale had been added, we might have done the same to 3000, and so on.

Example 2. Let it be required to subtract 749 from 856.

Find the point 856, as in the last example, and take the distance 749 in your compasses, and you will find, if you extend the other leg towards the beginning of the scale, it will rest between the point 1, which is 100, and not reach the next division, marked the tens, consequently 0 tens, but rest on the subdivision, showing seven units, that is, 100 + 0 + 7 = 107, the answer.

Example 3. Let it be required to find an arithmetical mean (that is, half the sum) between 856 and 749.

Find the sum of the two numbers, as shown in example 1; then half that distance in the scale, which may be found by trial with the compasses, will be found to be between 8 and 9 in the large divisions, which shows the first figure to be 800, and between the first small division and 0, which shows 0 tens, and between 2 and 3 of the subdivisions, which is two units; but, as it does not exactly agree with that point, we can easily estimate the distance between 2 and 3, where the compasses fall, which is half way; therefore we have the half of an unit, or 1-2 or ·5: thus we have 800 + 0 + 2 + ·5 =802·5, the correct answer.

Note.—It may be here observed, that as the scales most generally in use are a foot long, the small divisions will be each 100th part of a foot, or a little more than the tenth of an inch, which it will be difficult to divide into ten parts. For the subdivisions this certainly is the case, and for which reason the small divisions are generally divided into two equal parts, and it is left to the operator to judge by the eye, as near as he can, the fifth part of that half, which, by a little practice, may very nearly be estimated; and I would also observe, when the number is large, the unit, in most practical cases, is of no great signification: thus, if the work we have in hand is to be made to the scale of 100 feet to one foot, the thousandth part of a foot, more or less, can, practically, be of little consequence.

Being thus prepared, I will now endeavor to show the use of Gunter, and beg the reader to remember, that, by the help of artificial numbers, called logarithms, we may perform the operation of multiplication and division by means of addition and subtraction; and by taking the half of any logarithm, we find another logarithm, which answers to the square root of the number expressed by the first logarithm, and divided into three parts, the cube root, &c.

Construction of Gunter's Line of Numbers.—Take any convenient scale (suppose one foot), and set the distance on your Gunter equal unity. Now, this is to be divided into ten parts to correspond to the logarithms of $\frac{1}{10}$ $\frac{2}{10}$ $\frac{3}{10}$, &c. Now the logarithm of $\frac{1}{10}$ is equal to 0; therefore the first division corresponds to the beginning of the scale (we have here nothing to do with the indices of the logarithms, which only denote whether the numbers be whole or fractional.) Now find the logarithm of $\frac{2}{10}$, which is 301; take this from your scale (supposing it divided into 1000 equal parts), and apply it to your Gunter, and you have the point marked 2. Again, the logarithm of $\frac{3}{10}$ is 477; take from your scale 477, and apply it to your Gunter, you have the point 3; and in this manner proceed for all the large divisions: and in the same manner lay down your small divisions to correspond to the logarithms of $\frac{1}{100}$ $\frac{2}{100}$ $\frac{3}{100}$, &c. (and if your scale will admit of it, you may find your subdivision in the same manner); thus you will have a scale expressing the logarithms of all numbers from ·001 to unity, if your whole scale is unity; or of ·01 to 10, if your scale is 10, or from ·1 to 100, if your scale is 100; and, lastly, if your scale is 1000, you will have the logarithms of all numbers from unity to 1000: and hence, adding any two or more of these divisions together is the same thing as multiplying the numbers they represent on the scale, and subtracting any one from

another is the same as dividing the numbers they represent on the scale, &c. Now, owing to the smallness of the divisions (even when your scale is a foot long), those small divisions, as you approach the end of your scale, cannot be divided into more than ten equal parts. To be seen distinctly, the general practice on Gunter's scale is, from the commencement of the scale to the point 2, to divide it into ten parts or small divisions: and again, each part to be subdivided into five parts for the subdivisions, from the 2 to the 5, each small division into two parts, and from 5 upwards cannot be divided into more than ten parts, to be distinct; hence, in the use of the scale, when the compasses do not fall exactly on any division, you must estimate as near as you can the subdivisions.

Note.—For those mechanics who would wish to construct a Gunter scale for themselves, I would recommend the inspection of some tables in Fergusson's Select Exercises, page 191 and following; and where they will also find full directions for the construction of the plane scale, sector, and Gunter's scale, at page 206 and following.

Use of Gunter's Line of Numbers.—Before giving some examples, I must premise, that in all the best scales the numbers from 1 to 10 are repeated twice, and form two equal and similar scales; and that when two or more figures are used, the compasses will often extend beyond the second scale; therefore there is part of a third similar scale, if not the whole, added, which generally extends to the number 2 or 3 only; but if your rule is long enough, the whole of a third scale is very useful, particularly for the extraction of the cube root.

To illustrate the application, I shall give the solution of the following examples:

To multiply 46 *by* 54.—Place one leg of your compasses at the beginning of your scale, and extend the other to 46, that is, to four of the large divisions, and six of the next small ones; then, with that extent, place one leg on 54, that is, at five of the large divisions, and four of the next following small ones, and the other will extend to two of the large divisions on the second scale, and four of the next following small ones, and a little more than the half of a division, which we will estimate as 80 subdivisions; that is, $2000 + 400 + 80 = 2480$, which is within four units of the truth, and, as before observed, in general sufficiently exact for most practical purposes; but if the scale had been large enough to show the subdivisions, it is clear we should have had the true result.

To divide 2484 *by* 46.—Calling 2 in the second or right hand scale 2000, and each of the small divisions 100, set your compasses, with the distance 46 from the first scale, on the estimated point 2484, as near as you can guess; you will find the other leg, extended backwards to the first scale, will pitch on the point shown at 5 of the large divisions and 4 of the smaller ones, which is five tens, or 50, and four units, that is, $50 + 4 = 54$, the true answer.

To extract the Square Root of 324.—Calling the large divisions of the first scale hundreds, extend the compasses to three of the large divisions, two of the small ones, and estimate four subdivisions, that is, $300 + 20 + 4 = 324$; lay this distance down, for convenience, on a line drawn on paper, and divide it into two equal parts; take one of these parts in your compasses, and placing it at the scale, you will find it extend to 18 small divisions, that is, 18 units, the answer required.

I am afraid I have extended this article to too great a length and shall be thought prolix; but my aim has been to explain the use of the scale in a familiar manner to the workman; and though it may lay me under the censure of many versed in mathematical knowledge, it will, I am sure, be excused by those who look to the motives which induced me to be thus minute, which is, that *practical* mathematics may be extended as much as possible among the working classes. If this plan is persevered in, it will, I am confident, be of incalculable benefit to society in general. I am, sir, your obedient servant,

G. A. Seares.

Self-taught Philosophers.—We have heard and read much of self-made and self-taught men. The truth is, that every eminent man—especially among the literary, the scientific, the professional—has been a self-made man. Bacon and Locke, Milton and Newton, Burke and Mansfield, were as truly self-made and self-taught men as were Johnson and Franklin, Ferguson and Rittenhouse, Herschel and Fulton. The first enjoyed the advantages of a college directly, the latter indirectly: and all attained distinction by the same intellectual process. They severally availed themselves of all the instruments and sources of knowledge within their reach: and persevering industry, as a law of their existence, insured them victory

and honor. Rumford, Hutton, Davy, Sherman, Pope, Wythe, were as much debtors to the college as were Barrow, Edwards, Dwight, Fox, Scott, or Canning. The books, the science, the literary taste, the universal consideration attendant on superior mental endowments, which colleges had created, multiplied, diffused, and every where exhibited, led Franklin, as they have led thousands, to imitate, to master, to emulate, to rival, the excellence thus presented to their view and to their ambition. Had there been no colleges or seminaries of liberal learning—no literary or scientific enterprise or spirit abroad—Franklin might have been a Confucius or a Numa among barbarians, but he would never have been the first of philosophers and statesmen among the most enlightened nations of the earth.—[Lindley's Discourses.]

What is Education?—This may seem a very simple question, and very easily answered; but many who think so would really be very much at a loss to answer it correctly. Every man, in a free country, wants three sorts of education: one to fit him for his own particular trade or calling,—this is professional education; another to teach him his duties as a man and a citizen,—this is moral and political education; and a third, to fit him for his higher relations, as God's creature, designed for immortality,—this is religious education. Now, in point of fact, that is most useful to a man which tends most to his happiness; a thing so plain, that it seems foolish to state it. Yet people constantly take the word "useful" in another sense, and mean by it, not what tends most to a man's happiness, but what tends most to get money for him; and, therefore, they call professional education a very useful thing: but the time which is spent in general education, whether moral or religious, they are apt to grudge as thrown away, especially if it interferes with the other education, to which they confine the name of "useful;" that is, the education which enables a man to gain his livelihood. Yet we might all be excellent in our several trades and professions, and still be very ignorant, very miserable, and very wicked. We might do pretty well just while we were at work on our business; but no man is at work always. There is a time which we spend with our families; a time which we spend with our friends and neighbors; and a very important time which we spend with ourselves. If we know not how to pass these times well, we are very contemptible and worthless *men*, though we may be very excellent lawyers, surgeons, chemists, engineers, mechanics, laborers. or whatever else may be our particular employment. Now, what enables us to pass these times well, and our times of business also, is not our *professional* education, but our *general* one. It is the education which all need equally, namely—that which teaches a man, in the first place, his duty to God and his neighbor; which trains him to good principles and good temper; to think of others, and not only of himself. It is that education which teaches him, in the next place, his duties as a citizen—to obey the laws always, but to try to get them made as perfect as possible; to understand that a good and just government cannot consult the interests of one particular class or calling, in preference to another, but must see what is for the good of the whole; that every interest, and every order of men, must give and take; and that if each were to insist upon having every thing its own way, there would be nothing but the wildest confusion, or the merest tyranny. And because a great part of all that goes wrong in public or private life arises from ignorance and bad reasoning, all that teaches us, in the third place, to reason justly, and puts us on our guard against the common tricks of unfair writers and talkers, or the confusions of such as are puzzle-headed, is a most valuable part of a man's education, and one of which he will find the benefit whenever he has occasion to open his mouth to speak, or his ears to hear. And, finally, all that makes a man's mind more active, and the ideas which enter it nobler and more beautiful, is a great addition to his happiness whenever he is alone, and to the pleasure which others derive from his company when he is in society. Therefore it is most *useful* to learn to love and understand what is *beautiful*, whether in the works of God, or in those of man; whether in the flowers and fields, and rocks and woods, and rivers, and sea and sky; or in fine buildings, or fine pictures, or fine music; and in the noble thoughts and glorious images of poetry. This is the education which will make a man and a people good, and wise, and happy. Give this, and the ends of professional education can never be altogether lost—for good sense and good principle will insure a man's knowing his particular business; but knowledge of his business, on the other hand, will not insure *them*; and not only are sense and

goodness the rarest and most profitable qualities with which any man can enter upon life now, but they are articles of which there never can be a glut: no competition or over-production will lessen their value; but the more of them that we can succeed in manufacturing, so much the higher will be their price, because there will be more to understand and to love them.

Improvement in Social Condition.—The history of the United States of North America is, in some respects, one of the most instructive that we can turn to; because we are accurately acquainted with the origin of this social community, and are also enabled to trace its history in all its important facts, from the first establishment of the several colonies up to the present condition of the Union. Of all historical records none can be put in comparison with legislative enactments, as showing the condition of the people at any given period, and the degree of mental culture diffused among them. In the American States, even under their former colonial government, there were few men of any importance in the provinces who did not participate in some of the functions of government; and we may, therefore, consider the laws enacted at that period as indicative of the opinions held by the most influential classes.

We happen to have before us an old collection of Virginia laws, entitled, "A complete collection of the Laws of Virginia, at a Grand Assembly held at James City, 23d March, 1662;" a few extracts from which may not be uninteresting.

There appears to be in this volume only one law about education, which prescribes the founding of a college "for the advance of learning, education of youth, supply of the ministry, and promotion of piety." The law states how the money is to be raised; but as to its application nothing more is said, except that a piece of land is to be got, and, "with as much speed as may be convenient, housing is to be erected thereon for entertainment of students and scholars." The *housing* department seems to have been the uppermost thing in the legislature's thoughts; the providing of good teachers was a secondary consideration.

There are several enactments about "rewards for killing wolves," which at that time infested even the lower parts of Virginia. At the present day, owing to the increase of population, the wolf and other wild animals, though occasionally heard of, are but rarely seen even in the mountains, and seldom do any damage. The reward "for every wolf destroyed by pit, trap, or otherwise, is 200 pounds of tobacco."

Tobacco was the most common standard of value in Virginia at that time, as we see from this and numerous other instances, where fines, &c., are estimated at so many pounds of tobacco. Thus it is stated in enactment 35, that "the court shall not take cognizance of any cause under the value of 200 pounds of tobacco, or twenty shillings sterling, which a private justice may and is hereby authorized and empowered to hear and determine."

The following recipe for good order is contained in an enactment, entitled "Pillories to be erected at each Court:" "In every county the court shall cause to be set up a pillory, a pair of stocks, and a whipping-post, near the court-house, and a ducking-stool; and the court not causing the said pillory, whipping-post, stocks, and ducking-stool, to be erected, shall be fined 5000 pounds of tobacco to the use of the public."

In those days the following provision was made for extending the elective franchise, which appears founded on a rational principle: "Every county that will lay out 100 acres of land, and people it with 600 tytheable (taxable) persons, that place shall enjoy the like privilege of sending a burgess." The burgesses, together with their attendants, were free from arrest, from the time of election till ten days after dissolution of the assembly; this privilege, however, was somewhat modified by several clauses. Every burgess was allowed, during the sitting of the assembly, "150 pounds of tobacco, and cask, per day, besides the necessary charge of going to the assembly and returning." This practice of paying legislators, which, in America, originated under the Colonial system, is still continued in the United States. It did not entirely cease in England until the reign of Charles II. Andrew Marvel, one of the burgesses of Hull, was the last member of the House of Commons who appears to have accepted the wages which all were entitled to receive.

Among commercial restrictions we find an enactment prohibiting the planting of tobacco after the 10th of July, which was done for "the improvement of our only commodity, tobacco, which can no ways be effected but by lessening the quantity and amending the quality." That the former effect might pos-

sibly be produced by the enactment, without securing the latter, seems pretty certain. Another object that the government had in view was to compel the people to become silk-growers against their will. "Be it, therefore, enacted," says the legislature, "that every proprietor of land within the colony of Virginia shall, for every hundred acres of land holden in fee, plant upon the said land ten mulberry-trees at twelve foot distance from each other, and secure them by weeding and a sufficient fence from cattle and horses." Tobacco fines, as usual, were enacted in case the planting and weeding were not duly performed; and further, "there shall be allowed in the public levy to any one for every pound of wound silk he shall make, fifty pounds of tobacco, to be raised in the public levy, and paid in the county or counties where they dwell that make it." This act was passed in 1662, and probably continued in force for a long time; but Virginia did not, therefore, become a silk-growing country, nor has it yet, though many parts are well adapted to raise this commodity. People, we presume, have hitherto found other things more profitable than silk.

The following enactment has a most barbarous character about it, not unmixed with something extremely ludicrous as to the idea of the legislature trying to prevent women from talking: "Whereas many babbling women slander and scandalize their neighbors, for which their poor husbands are often involved in chargeable and vexatious suits, and cast in great damages: Be it therefore enacted, that in actions of slander, occasioned by the wife, after judgment passed for the damages, the woman shall be punished by ducking; and if the slander be so enormous as to be adjudged at greater damages than 500 pounds of tobacco, then the woman to suffer a ducking for each 500 pounds of tobacco adjudged against the husband, if he refuse to pay the tobacco."

This old statute book of Virginia is full of enactments such as we have quoted; some exceedingly mischievous, and others very ludicrous. It would, however, be unfair to say that there are not also some good regulations in it. Were a history of our own or any other country to be written, founded on the legislative enactments, and illustrated, whenever it was possible, by individual cases on record, we should then begin to have some idea of what history is. Instead of the splendors or the follies of a few who occupy the attention of the historian, we should be able to form a more complete picture of the condition of the whole community, and a more exact estimate of the progress which has been made in social knowledge.

Salt.—There are many countries on the habitable globe where salt has never yet been found, and whose commercial facilities being extremely limited, the inhabitants can only occasionally indulge themselves with it as a luxury. This is particularly the case in the interior of Africa. "It would," says Mungo Park, "appear strange to an European to see a child suck a piece of rock-salt as if it were sugar. This, however, I have frequently seen; although the poorer class of inhabitants are so very rarely indulged with this precious article, that to say that a man eats salt with his provisions is the same as saying he is a rich man. I have suffered great inconvenience myself from the scarcity of this article. The long use of vegetable food creates so painful a longing for salt, that no words can sufficiently describe it."—[Park's Travels into the Interior of Africa.]

New Printing Machine.—A new printing machine has been invented in England, by a practical printer, which is highly spoken of in one of the late Liverpool papers. We subjoin the editor's notice of it:

Mr. J. Kitchen, of the Newcastle Journal, has invented a printing press, which bids fair to revolutionize this department of the arts. It bears no analogy, even in appearance, to any machine for the purpose hitherto known. The *form* can be fixed in its place in a single moment, and will, when adjusted, remain stationary until the work is finished. Complete facilities are given for regulating the power, and the quantity of ink, and for overlaying and obtaining register. The same machine will be equally applicable for the smallest job or the largest sheet; it will be perfectly under control, and only require one man during the process of printing; or where great speed is required, and the work is heavy, a man and a *fly-boy:* whilst it can be sold for the same price as the common press. Mr. Kitchen is now engaged in the application to his invention of a clock-work movement, so that a machine may keep a register of its own work, and thus act as a check upon waste of paper and idleness in the absence of the employer or overseer.

The inventor, when practically engaged in the business several years ago, was struck

with the anomaly, that whilst printing was the medium of extending the boundary of knowledge, and communicating to the public every experiment in science or mechanics, "The Press" itself has remained precisely the same, in principle, to that employment when the art was first introduced into this kingdom. Lord Stanhope made the machine of metal instead of wood, and conferred upon it greater power, with several minor alterations. This gave an impulse to improvements, and presses are now made greatly superior to Lord Stanhope's, but none of them deserve the name of new inventions. The slow lumbering process of frisket and tympan ; the table with alternate motion, and the dirty and inconvenient appendage of an inking table, detached from the press, are still scrupulously preserved, all of which were employed for the same purpose in the time of Caxton.

Mr. Kitchen's first effort was directed to the construction of a press on the old principle just described, with the advantages of a self-inking apparatus, and obtaining increased pressure by the application of hydraulic power. In the first object he succeeded ; but after a long series of experiments, found that the requisite *speed* could not be obtained by hydraulics, and turned his attention to some other plan.

Since these experiments were commenced, the splendid *foreign* invention of the steam press has been introduced into this country; but it is at once so complicated, cumbersome and costly, that it can only be purchased by large capitalists, and employed in extensive offices. The same remarks will apply to the several modifications of it, to work without steam.

A few Remarks on the Relation which subsists between a Machine and its Model. By Edward Sang, Teacher of Mathematics, Edinburgh.

At first sight, a well constructed model presents a perfect representation of the disposition and proportion of the parts of a machine, and of their mode of action.

Misled by the alluring appearance, one is apt, without entering minutely into the inquiry, also to suppose that the performance of a model is, in all cases, commensurate with that of the machine which it is formed to represent. Ignorant of the inaccuracy of such an idea, too many of our ablest mechanicians and best workmen waste their time and abilities on contrivances, which, though they perform well on the small scale, must, from their very nature, fail when enlarged. Were such people acquainted with the mode of computing the effects, or had they a knowledge of natural philosophy, sufficient to enable them to understand the basis on which such calculations are founded, we should see fewer crude and impracticable schemes prematurely thrust upon the attention of the public.. This knowledge, however, they are too apt to regard as unimportant, or as difficult of attainment. They are startled by the absurd distinction which has been drawn between theory and practice, as if theory were other than a digest of the results of experience ; or, if they overcome this prejudice, and resolve to dive into the arcana of philosophy, they are bewildered among names and signs, having begun the subject at the wrong end. That the attainment of such knowledge is attended with difficulty is certain, but it is with such difficulty only as can be overcome by properly directed application. It would be, indeed, preparing disappointment to buoy them up with the idea, that knowledge, even of the most trivial importance, can be acquired without labor. Yet it may not be altogether unuseful, for the sake both of those who are already, and of those who are not, acquainted with these principles, to point out the more prominent causes, on account of which the performance of no model can, on any occasion, be considered as representative of that of the machine. Such a notice will have the effect of directing the attention, at least, to this important subject. In the present state of the arts, the expense of constructing a full-sized instrument is, in almost every instance, beyond what its projector would feel inclined, or even be able, to incur. The formation of a model is thus universally resorted to, as a prelude to the attempt on the large scale. An inquiry, then, into the relation which a model bears to the perfect instrument, can hardly fail to carry along with it the advantage of forming a tolerable guide, in estimating the real benefit which a contrivance is likely to confer upon society.

In the following paper I propose to examine the effect of a change of scale on the strength and on the friction of machines, and, at the same time, to point out that adherence to the strictest principles which is apparent in all the works of nature, and of which I mean to avail myself in fortifying my argument.

Previous, however, to entering on the subject-proper, it must be remarked that, when we enlarge the scale according to which any

instrument is constructed, its surface and its bulk are enlarged in much higher ratios. If, for example, the linear dimensions of an instrument be all doubled, its surface will be increased four, and its solidity eight-fold. Were the linear dimensions increased ten times, the superfices would be enlarged one hundred, and the solidity one thousand times. On these facts, the most important which geometry presents, my after-remarks are mostly to be founded.

All machines consist of moveable parts, sliding or turning on others, which are bound together by bands, or supported by props. To the frame work I shall first direct my attention.

In the case of a simple prop, destined to sustain the mere weight of some part of the machine, the strength is estimated at so many hundred weights per square inch of cross section. Suppose that, in the model, the strength of the prop is sufficient for double the load put on it, and let us examine the effect of an enlargement, ten-fold, of the scale according to which the instrument is constructed. By such an enlargement, the strength of the prop would be augmented 100 times; it would be able to bear 200 loads such as that of the model, but then the weight to be put on it would be 1000 times that of the small machine, so that the prop in the large machine would be able to bear only the fifth part of the load to be put on it. The machine, then, would fall to pieces by its own weight.

Here we have one example of the erroneous manner in which a model represents the performance of a large instrument. The supports of small objects ought clearly to be smaller in proportion than the supports of large ones. Architects, to be sure, are accustomed to enlarge and to reduce in proportion; but nature, whose structures possess infinitely more symmetry, beauty, and variety, than those of which art can boast, is content to change her proportions at each change of size. Let us conceive an animal having the proportions of an elephant and only the size of a mouse; not only would the limbs of such an animal be too strong for it, they would also be so unwieldy that it would have no chance among the more nimble and better proportioned creatures of that size. Reverse the process, and enlarge the mouse to the size of an elephant, and its limbs, totally unable to sustain the weight of its immense body, would scarcely have strength to disturb its position even when recumbent.

The very same remarks apply to that case in which the weight, instead of compressing, distends the support. The chains of Trinity Pier are computed to be able to bear nine times the load put on them. But if a similar structure were formed of ten times the linear dimensions, the strength of the new chain would be one hundred times the strength of that at Trinity, while the load put upon it would be one thousand times greater; so that the new structure would possess only nine-tenths of the strength necessary to support itself. Of how little importance, then, in bridge building, whether a model constructed on a scale of perhaps one to a hundred support its own weight! Yet, on such grounds, a proposition for throwing a bridge of two arches across the Forth, at Queensferry, was founded. Putting out of view the road-way and passengers altogether, the weight of the chain alone would have torn it to pieces. The larger species of spiders spin threads much thicker, in comparison with the thickness of their own bodies, than those spun by the smaller ones. And, as if sensible that the whole energies of their systems would be expended in the frequent reproduction of such massy webs, they choose the most secluded spots; while the smaller species, dreading no inconvenience from a frequent renewal of theirs, stretch them from branch to branch, and often from tree to tree. I have often been astonished at the prodigious lengths of these filaments, and have mused on the immense improvement which must take place in science, and in strength of materials too, ere we could, individually, undertake works of such comparative magnitude.

When a beam gives support laterally, its strength is proportioned to its breadth, and to the square of its depth conjointly. If, then, such a beam were enlarged ten times in each of its linear dimensions, its ability to sustain a weight placed at its extremity would, on account of the increased distance from the point of insertion, be only one hundred times augmented, but the load to be put upon it would be one thousand times greater; and thus, although the parts of the model be quite strong enough, we cannot thence conclude that those of the enlarged machine will be so.

It may thus be stated as a general principle, that, in similar machines, the strengths of the parts vary as the square, while the weights laid on them vary as the cube of the corresponding linear dimension.

This fact cannot be too firmly fixed in the minds of machine makers; it ought to be taken

into consideration even on the smallest change of scale, as it will always conduce either to the sufficiency or to the economy of a structure. To enlarge or diminish the parts of a machine all in the same proportion, is to commit a deliberate blunder. Let us compare the wing of an insect with that of a bird: enlarge a midge till its whole weight be equal to that of the sea-eagle, and, great as that enlargement must be, its wing will scarcely have attained the thickness of writing paper; the falcon would feel rather awkward with wings of such tenuity. The wings of a bird, even when idle, form a conspicuous part of the whole animal; but there are insects which unfold, from beneath two scarcely perceived covers, wings many times more extensive than the whole surface of their bodies.

The larger animals are never supported laterally; their limbs are always in a position nearly vertical: as we descend in the scale of size the lateral support becomes more frequent, till we find whole tribes of insects resting on limbs laid almost horizontally. The slightest consideration will convince any one that lateral or horizontal limbs would be quite inadequate to support the weight of the larger animals. Conceive a spider to increase till his body weighed as much as that of a man, and then fancy one of us exhibiting feats of dexterity with such locomotive instruments as the spider would then possess!

The objects which I have hitherto compared have been remote, that the comparisons might be the more striking; but the same principles may be exhibited by the contrast of species the most nearly allied, or of individuals even of the same species. The larger species of spiders, for instance, rarely have their legs so much extended as the smaller ones; or, to take an example from the larger animals, the form of the Shetland poney is very different from that of the London dray horse.

How interesting it is to compare the different animals, and to trace the gradual change of form which accompanies each increase of size! In the smaller animals, the strength is, as it were, redundant, and there is room for the display of the most elaborate ornament. How complex or how beautiful are the myriads of insects which float in the air, or which cluster on the foliage! Gradually the larger of these become more simple in their structure, their ornaments less profuse. The structure of the birds is simpler and more uniform, that of the quadrupeds still more so. As we approach the larger quadrupeds, ornament, and then elegance, disappear. This is the law in the works of nature, and this ought to be the law among the works of art.

Among one class of animals, indeed, it may be said that this law is reversed. We have by no means a general classification of the fishes; but, among those with which we are acquainted, we do not perceive such a prodigious change of form. Here, however, the animal has not to support its own weight; and whatever increase may take place in the size of the animal, a like increase takes place in the buoyancy of the fluid in which it swims. Many of the smaller aquatic animals exhibit the utmost simplicity of structure; but we know too little of the nature of their functions to draw any useful conclusions from this fact.

Excess in the Pursuit of Knowledge.—The chief end why we are to get knowledge here is to make use of it for the benefit of ourselves and others in this world; but, if by gaining it we destroy our health, we labor for a thing that will be useless in our hands; and if by harassing our bodies (though with a design to render ourselves more useful), we deprive ourselves of the abilities and opportunities of doing that good we might have done with a meaner talent—which God thought sufficient for us, by having denied us the strength to improve it to that pitch which men of stronger constitutions can attain to, —we rob God of so much service, and our neighbor of all that help, which, in a state of health, with moderate knowledge, we might have been able to perform. He that sinks his vessel by overloading it, though it be with gold and silver and precious stones, will give his owner but an ill account of his voyage.—[Locke.]

Water Color for Rooms.—Take a quantity of potatoes and boil them; then bruise and pour boiling water upon them until a pretty thick mixture is obtained, which is to be passed through a sieve. With boiling water then make a thick mixture of whitening, and put it to the potato mixture. To give color, if white is not wanted, add different colored ochres, lampblack, &c. according to circumstances. This paint dries quickly, is very durable, has a good appearance to the eye, and is moreover very cheap.—[London Paper.]

Injury of Turpentine to Paint. By Robt. R. Harden. [From the Southern Planter.]

We use paint on our wooden buildings with two objects: first, ornament—second, durability. Was oil used by itself, without any coloring matter, the wood would be made more durable than it is with paint; but as ornament is a considerable part of the objects of painting, and as the addition of paint to the oil, when properly prepared, does not very materially injure the preservative qualities of the oil, the ornamental effect of the coloring more than counterbalances the injury it does. Paint, when properly prepared, therefore, while it is highly ornamental to wooden buildings, so materially contributes towards their durability, that there is economy in using it. But as it is generally prepared, (I may say always,) the ornamental effect of it on the outside of buildings is made only temporary, and its preservative qualities wholly destroyed. It is only necessary to look at our quickly decaying wooden buildings, with the paint washed off more or less in different places, according as it is exposed to the sun and rain, to be satisfied that the expense of painting has added very little towards preserving the building; and whether a building looks better without paint, or with paint nearly all washed off, with here and there a little remaining to show that it once was painted, taste must determine. If what I have stated be a fact, that paint, as mostly prepared, is of little value, it will be well to look into the cause of it, that the evil may be remedied; and if I give the correct cause, happily the evil is removed without expense or trouble; or rather, it is cheaper to paint well than in this defective manner. We have only to leave out the spirits of turpentine, and we will have good paint. Ask the painter why he adds it to the paint, and he will tell you to make it dry quick. This is just the same as saying, to destroy the oil, which renders the paint useless. Now let us reason upon it, and see if this is correct. If we pour oil on wood it soaks into it, and after it is all soaked up, if we apply more oil, it will strike still deeper and soak up more; when it has penetrated sufficiently deep into the wood as to prevent moisture from rain, &c. penetrating as deep as itself, the wood is rendered very lasting. This would be the case if a building was simply covered with two coats of oil without paint. If we give it only one coat of oil, with a sufficient quantity of paint to give it color, the wood would so quickly soak up the oil that the paint would be left a dry powder on the building, that would be easily rubbed or washed off. If we give it first a coat of oil with a little paint added to it, the oil soaks into the pores; another coat of oil with the proper quantity of paint, while the pores are filled with the recently put on or first coat, remains sufficiently long before the oil is soaked up by the pores for a part of it to dry with the paint, which forms a covering of paint. This is the advantage of giving two coats of paint; if the first coat was oil only, it would be better. When a house is thus painted, all the injury done by the paint is the oil which it retains and prevents from soaking into the wood; and this is in part, perhaps wholly, counterbalanced in forming a firm external covering, which tends to exclude moisture; thus painted, a building is preserved and ornamented. Now what will be the effect of adding spirits of turpentine to the oil? We know of nothing better calculated to destroy our intentions in the use both of the oil and paint than this addition of turpentine. Every housekeeper knows that if oil is on the floor, spirits of turpentine is the application to remove it. Every wash-woman knows that if oil is on her clothes, turpentine is the application to remove it; and how does it remove it when the oil and turpentine are added together? A chemical union takes place and the qualities of both are destroyed, and although either the oil or turpentine by themselves when applied on wood would add to its durabitity, yet when added together the original quality of both are destroyed, and the application is useless, just as an acid and alkali, when mixed together, destroy the qualities of each other and the effect of neither remains. Now, when a building is painted with two coats of paint to which spirits of turpentine is added, instead of the first covering of oil (which has very little paint) being soaked up, and the second covering, as the pores are already fed, soaking up the oil so slow that a part of the oil may dry in the paint, thus making a firm coat of paint on the surface, which will exclude moisture and prevent the evaporation of the oil, thus making the wood almost as lasting as time, and the color to remain as long as the wood lasts, what will be the effect of this addition of turpentine? The oil is decomposed, and instead of soaking into the wood and slowly drying in the paint to give a firm covering, it is quickly evaporated by the sun, the paint is left a useless powder on the wood; where it is not sheltered from the rain, it is soon

washed away; and in places where it only gets wet without being washed off, as the qualities of the oil are destroyed, it retains moisture and hastens decay. We have only to go to a house which was painted white, and examine the somewhat sheltered spots where they get wet by showers, tho' the rain does not beat upon them so as to wash off the paint, and scratch off the paint, and we will find the surface in a state of decay, from the paint not excluding moisture, but retaining it. When pine wood is painted, it should more especially have only oil and paint without the spirits of turpentine, as there is in the wood turpentine sufficient to injure the oil. If we examine the shingles or weather-boarding of a house, we will find wherever there is a knot or *fat place*, there the oil is decomposed by the turpentine in the wood, and the paint destroyed, even where no spirits of turpentine was added to the paint.

The oldest paintings we have appear as warm and glowing as when first executed, while the paintings of the first masters of modern times are injured, mostly as I think by the free use of turpentine. The fine paintings even of Sir Joshua Reynolds are losing their beauty. By some it is supposed that the paints used now are not as good as they were in former days. 'Tis not the fault of the materials, but the preparation. Oil, for instance, and white lead, are as good now as they ever were, and were they used without turpentine or any thing else, as the painters say to make them dry, (or as we say, to decompose the oil and destroy it,) would last as long and be as good as they ever were. If we calculate the annual amount of money used in the purchase of turpentine, and to this add the amount of loss from the injury it does, we will find it an enormous expense.

Perhaps nine out of ten houses that take fire from sparks falling on the roof, do so from this mossy growth, which never is produced on wood that is oiled; were shingles dipped in hot oil before putting them up, it would be a preventive from fire from sparks. A few days ago, during almost a calm, at mid day, when only a few coals were in the fire place, my house roof was discovered to be on fire. As there was no ladder nor no way of getting at the fire, it seemed as though the house would burn down. A very strong man, however, by getting in the window of a house not far off, was able to deaden the fire a little by throwing water with great strength; some drops would reach the fire: thus some little time was given for reflection. A man of great muscular strength with a small hatchet commenced cutting through the ceiling and sheeting. The fire began to blaze, the wind began to rise, all hope of extinguishing the fire was gone: he had however cut a hole through, and was able to tear off the boards and put out the fire. These shingles, upon examination, were found sound, but they were covered with this mossy growth. A very small spark must have set it on fire, for upon trial it was found almost as quick to take as gunpowder. Had these shingles been dipped in oil before they were put on the house, I would have been safe from such an accident, not only now, but for many years to come.

Starvation Farm, Feb. 12, 1833.

Foul Casks.—Foul pails, tubs, or casks, intended for butter or any other purpose, may be cleansed by putting in some bran, indian meal, or flour, and filling up with water; a fermentation will take place which will perfectly cleanse the vessel. The liquid is the better for hogs after undergoing fermentation; consequently there is no expense attending the process.

Hancock's Steam Carriage.—The following letter of Mr. Hancock, showing the performances of his Steam Omnibus, is taken from Bell's Weekly Messenger, to the Editor of which it is addressed:

Stratford, May 3, 1833.

Sir,—More than six years have elapsed since I began my experiments on Steam Locomotion, and I have followed them with an ardor that did not admit of any diversion from the object which I kept steadily in view.

During the past fortnight I have exhibited daily on the Paddington road a Steam Omnibus, the result of my experience; and having hitherto steered clear both of extravagant anticipations and exaggerated statements, I should be sorry now if any such should find their way into the public prints; and in order to prevent this, as far as I am able, I beg to hand you an account of each day's performance, if you think it is of sufficient interest to occupy a place in your columns.

Having furnished these data, and given to the public opportunities of witnessing the performance of this carriage in the streets and on the most crowded and hilly road in the immediate neighborhood of the metropolis, I trust that I have demonstrated to the most sceptical the practicability of applying

steam economically to the purposes of inland transport.

	Miles.	Total time.	Delays.	Travelling time.
		min.	min.	min.
April 22—From City-road to Paddington, thence to London Wall, and back to City-road - - - - - -	10	68	18	50
23—City-road to Paddington, and back	8½	71	9	62
24—Do. do. - - - -		64	11½	53
25—From City-road to Paddington, and back to the middle of Pentonville-hill, where the pressure of the steam broke the piston of the off Engine - -				
26—Put in new piston, double the strength of the former. From City-road to Paddington, and back - -	8½	49	5	44
27—Do. do. - - - - -		50	5½	44½
29—Do. do. - - - - -		51	5½	45½
30—Do. do. - - - - -		51	6½	45
May 1—From City-road to Paddington, thence round Finsbury-square, and back to City-road - - - - -	10	78	15	63
2—Do. do. - - - - -		67	9	58
3—Do. do. - - - - -		79	18	61

The average quantity of coke used has been three bushels each journey. I am, Sir, your obedient servant, W. Hancock.

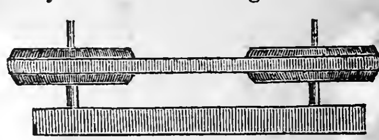
Public Instruction in France.—The minister of public instruction in France has addressed circulars to the rectors, &c. for the establishment of schools for primary teachers. Within two years, this important class of schools,—in which we are so deficient in the United States,—has increased in number from 30 to 47. What might one such school accomplish in each of our new States.

Much interest is shown in France, especially in certain departments, in the establishment of schools. The whole number of schools in the kingdom, in 1832, was 4,055, with 231,365 scholars: a greater number of scholars than in 1829. Schools have been established, where there were none in 1829, in 2,741 communes, (or townships.) The schools of mutual instruction have increased 536, and the normal schools 34.

Schools and courses of instruction for the adults and laborers of Paris,—founded by individuals and societies,—are encouraged by the minister of public instruction, unless they have a political bearing.—[New-York Advocate.]

Of Wheel Work.—In treating of the simple mechanical power, called the wheel and axle, (see The Artisan, vol. i. p. 86), we stated that motion was communicated from one wheel to another, either by belts and straps passing over them, or by teeth cut in the circumference of each, and working in one another. We shall now enter a little more fully into the subject and endeavor to explain some of the most useful principles upon which this branch of practical mechanics depends, and also to point out the various methods of applying this mechanical power in the motion of different kinds of machinery.

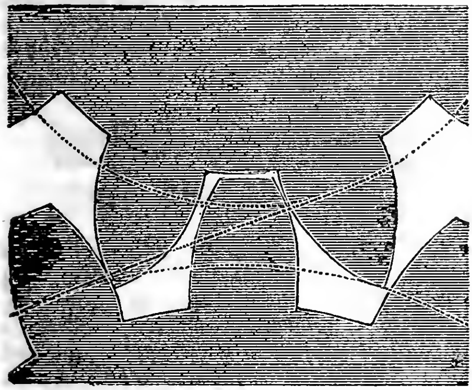
Where a broad strap runs on a wheel, it is usually confined to its situation, not by causing the margin of the wheel to project, but, on the contrary, by making the middle prominent, as represented by the following wheel or pulley, on which a broad strap runs, the surface being convex; the wheel which drives it is of a similar form but its upper part only is shown in the figure.



The reason of the middle being made prominent may be understood by examining the manner in which a tight strap, running on a cone, would tend to run towards its thickest part. Sometimes also pins are fixed in the wheels, and admitted into perforations in the straps; a mode only practicable where the motion is slow and steady. A smooth motion may also be obtained, with considerable force, by forming the surfaces of the wheels into brushes of hair. More commonly, however, the circumferences of the contiguous wheels are formed into teeth, impelling each other, as with the extremities of so many levers, either exactly or nearly in the common direction of the circumferences; and sometimes an endless screw is substituted for one of the wheels.

In forming the teeth of wheels, it is of consequence to determine the curvature which will produce an equable communication of motion with the least possible friction. For the equable communication of motion, two methods have been recommended; one, that the lower part of the face of each tooth should be a straight line in the direction of the radius, and the upper, a portion of an epicycloid; that is, of a curve described by a point of a circle rolling on the wheel, of which the diameter must be half that of the opposite wheel; and in this case it is demonstrable, that the plane surface of each tooth will act on the curved surface of the opposite tooth, so as to produce an equable angular motion in both wheels: the other method is, to form all the

surfaces into portions of the involutes of circles, or the curves described by the point of a thread which has been wound round the wheel while it is uncoiled; and this method appears to answer the purpose, in an easier and simpler manner than the former. The following figure represents the teeth, &c. of two wheels, formed into involutes of circles, described by uncoiling a thread from the dotted circles; the point of contact of the teeth being always in the straight line, which ouches both circles.



It may be experimentally demonstrated, that an equable motion is produced by the action of these curves on each other; if we cut two boards into forms, terminated by them, divide the surfaces by lines into equal or proportional angular portions, and fix them on any two centres, we shall find that, as they revolve, whatever parts of the surfaces may be in contact, the corresponding lines will always meet each other.

Both of these methods may be derived from the general principle, that the teeth of the one wheel must be of such a form, that their outline may be described by the revolution of a curve upon a given circle, while the outline of the teeth of the other wheel is described by the same curve revolving within the circle. It has been supposed by some of the best officers, that the epicycloidal tooth has also the advantage of completely avoiding friction; this is, however, by no means true, and it is even impracticable to invent any form for the teeth of a wheel which will enable them to act on other teeth without friction. In order to diminish it as much as possible, the teeth must be as small and as numerous as is consistent with strength and durability; for the effect of friction always increases with the distance of the point of contact from the line joining the centres of the wheels. In calculating the quantity of the friction, the velocity with which the parts slide over each other has generally been taken for its measure; this is a slight inaccuracy of conception, for the actual resistance is not at all increased by increasing the relative velocity; but the effect of that resistance, in retarding the motion of the wheels, may be shown, from the general laws of mechanics, to be proportional to the relative velocity thus ascertained.

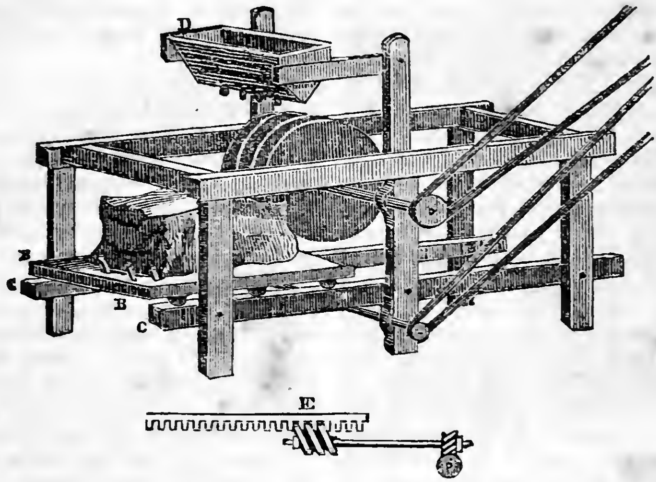
When it is possible to make one wheel act on teeth fixed in the concave surface of another, the friction may be thus diminished in the proportion of the difference of the diameters to their sum.

Hamilton's Patent Sawing and Boring Machine.—We have experienced much gratification in examining this useful labor-saving machine; and we are perfectly satisfied that it is destined to be of great public utility in cheapening the price of those articles which are in use by all classes of society, and will at the same time be a source of great profit to the ingenious mechanic who has invented it. We have no means of ascertaining the precise amount of labor and expense which this machine will save, but we venture to hazard the opinion that a man and two apprentices will accomplish more in *twelve* hours than *forty* experienced journeymen can accomplish at the same work during the same period of time. It is withal one of those inventions which require no extraneous aid to bring it into immediate usefulness. The proprietor has commenced working it daily, and in a ware-room adjoining the machine he offers for sale its produce at from thirty to fifty per cent. less than the market price. This simple fact and the certainty that the work is in all its parts more perfect than that manufactured by hand, has produced a demand more than equal to the supply.

The machine is admirably well adapted to any sort of sawing that is usually done by hand or cross-cut sawing. Tenons, mitre-joints, &c. are cut with the greatest precision. In all sorts of pannel work and small framing it will be very useful. It is peculiarly adapted to sawing regular and eccentric circles, such as felloes for wheels, chair tops, seats, legs, and backs, and circular blocks for brushes; and it saws chair tops and seats with great accuracy on a bevel.

Each segment of a wheel is cut its proper length and proper inclination for the joint—the holes are bored for the dowels and spokes, and the hubs are bored on a principle entirely new, making every spoke stand with the greatest exactness from the centre to the extreme of the circle. The machine is perfectly simple in its construction, not liable to get out of repair, and easy to manage and understand. A few hours' acquaintance with it will enable any one, whether mechanic or otherwise, to operate on it as well as the inventor. It is only six feet square, and is propelled by a steam engine of two-horse power.

A part of the principle of the same machine is applied to a small portable frame, and used for sawing wood for the fire with a rapidity really astonishing.—[Courier & Enquirer.]



Specification of a patent for an improvement in the method of sawing Marble, and other stone, and cutting or working mouldings, or groovings, thereon, and polishing the same. Granted to Isaac D. Kirk, city of Philadelphia. [From the Journal of the Franklin Institute.]

References—A, The saws, or the moulding cylinder of soft cast iron; B, Carriage to support and carry forward the marble, or stone; C C, Rails on which the carriage travels; D, Hopper for sand and water; E, Apparatus for advancing the carriage.

To all to whom these presents shall come, be it known, that I, Isaac D. Kirk, of the city of Philadelphia, and state of Pennsylvania, have invented a new and useful improvement in the method of sawing marble and other stone, and cutting, or working, mouldings, or groovings, thereon, and polishing the same; the sawing being performed by means of an improved revolving, circular, metallic plate, smooth, or without teeth, upon the face, or edge, operating by friction with sand and water upon the material to be cut; and the moulding, or grooving, and polishing, being effected by means of the improved revolving moulding and polishing cylinder, or wheel, operating in cutting mouldings by friction with sand and water upon the surface to be wrought; and in polishing by friction, in like manner, with putty, buff, pumice-stone, or some other suitable material; viz. one or more circular metallic plates, smooth or not serrated upon the face, or cutting edge, (copper, or soft iron, are deemed preferable,) are securely fixed, vertically, upon a horizontal shaft, or spindle, of iron, of any required dimensions, passing through the centre of the plate, or plates, and supported at each end by a proper frame of wood, or of cast iron, upon which the shaft works. On one end of the shaft is a cog wheel to connect it to the moving power.

Where two or more plates are used on the same shaft, they are secured at the proper distance from, and parallel to, each other, by circular metallic bands of a thickness adapted to the intended thickness of the slab, or slabs, to be cut; which bands are fitted upon and around the shaft between the plates, or saws. Under the shaft, at the distance

of a little more than the radius of the plates, or saws, is a carriage on friction rollers, or wheels, resting on a permanent railway, to support and carry forward the stone, or marble, to the plates, or saws; it is moved either by a rack and pinion, or by weights and pulleys. Over the saws is fixed a hopper, filled with sand and water, which is carried by a conductor leading from an aperture in its bottom, to the saws, at the point of their contact with the stone or marble. The plates, or saws, may be made of any required dimensions, and must be wrought to a uniform thickness throughout, with the cutting edge smooth, or not serrated, and either rounded, bevelled or flat. The improved moulding and polishing cylinder, or wheel, is of any metal, (cast iron is preferable for moulding, and some of the softer metals, and wood, for polishing,) and of any requisite dimensions, having the converse of the intended moulding, or grooving, either cast or turned upon its surface, or periphery, by means of which any series of mouldings, or groovings, can be wrought on a surface of marble, or stone, at one operation, and in like manner be polished. It is fixed upon a horizontal shaft passing through its axis, which is turned by a cog wheel connecting it to the power, and operates on the material to be wrought, by revolving vertically against its surface in contact with sand and water in cutting mouldings, and in contact with pumice-stone, buff, putty, or some other suitable material in polishing. A cylinder, having a regular smooth surface, is used in like manner for flatting, and for polishing a plain surface. The marble, or stone, is carried forward, and under the moulding and polishing cylinders, by a mechanical arrangement similar to that before described.

The polishing cylinder is similar in form to the above, and used in like manner with polishing powder, as putty, buff, &c. instead of sand, and is made of wood, or some of the softer metals.

The improvement claimed by said Isaac D. Kirk consists in the sawing of marble, or other stone, by means of a revolving, circular, metallic plate, smooth, or not serrated, on the face, or edge, and applied with sand and water, as is done with the straight saw; and also in making or forming upon the surface, or periphery, of a metallic or wooden cylinder, or wheel, the converse of the intended moulding, or grooving; by means of which, a series of mouldings, or grooves, can be wrought on a surface of marble, or stone, at one operation, with sand and water; and in like manner, polished with putty, buff, pumice-stone, or other polishing material.

ISAAC D. KIRK.

REMARKS BY THE EDITOR.—From the information which we have received relating to the above described machine, its invention appears likely to mark an important epoch in the art of working marble; this information has been derived from a gentleman of much intelligence, residing in Philadelphia, who relates only what he himself witnessed, as regards the operation of the machinery, and which we will give in his own words.

"I embrace," he says, "this opportunity of stating what I have seen of the practical operation of the experimental machinery erected here by the patentee; which, I will observe, was of very rude construction, and capable of great improvement in its application on a more extended scale. The saw used in these experiments was a circular copper plate of thirty-one inches in diameter, attached to a shaft working horizontally on a slight frame of wood, and turned by means of a band and whirl. I have seen this saw, worked by the power of *one man*, cut through a block of our hardest marble, one foot in length and depth, or one foot square, in thirty minutes; and with increased power I doubt not it might be done in much less time.

"I also, at the same time, saw the moulding wheel, of cast iron, work out mouldings on a slab of marble one foot in length, in one minute and a half, and have no doubt that the same could be done more rapidly with machinery less rudely constructed.

"The marble is left by the saw, as well as by the moulding wheel, or cylinder, in a state fit for polishing, without any preparatory chiselling, or rubbing down with sand; and the polishing is performed in the same manner as the moulding, and with equal or greater rapidity."

We are informed that in the sawing of large blocks of marble in the ordinary way, from six to eight square feet is accounted a good day's work; but that in the cutting of small blocks, a workman can rarely cut more than two or three feet. From the experiment above recited, it appears fair to conclude that ten times as much can be effected by Kirk's machinery, when operating on small blocks, and probably upon any which are not too large for the circular saw. This also, it may be observed, is not limited in its diameter by the same cause which limits

those made of a single plate for sawing timber, namely, the expansion by heat, which causes the saw to buckle, an effect which will be prevented in the cutting of stone by the saw being kept constantly wet. The cost of a saw will be saved in the work performed by it in one or two days.

The letter from which we have quoted does not mention the width of the mouldings wrought by the revolving moulding wheel, but it appears likely that the saving of time in this usually slow operation will much exceed that effected in sawing.

We perceive by the records of the patent office, that Mr. Kirk has assigned his right to Mr. Richard S. Risley, of Philadelphia.

Antiquity of Mechanical Science.—We read in Genesis, that ships were as old, even on the Mediterranean, as the days of Jacob. We likewise read that the Philistines brought thirty thousand chariots into the field against Saul; so that chariots were in use 1070 years before Christ. And about the same time architecture was brought into Europe. And 1030 years before Christ, Ammon built long and tall ships with sails, on the Red Sea and the Mediterranean. And, about ninety years after, the ship Argo was built; which was the first Greek vessel that ventured to pass through the sea, by help of sails, without sight of land, being guided only by the stars. Dædalus also, who lived 980 years before Christ, made sails for ships, and invented several sorts of tools, for carpenters and joiners to work with. He also made several moving statues, which could walk or run of themselves. And, about 800 years before Christ, we find in 2 Chron. xv. that Uzziah made in Jerusalem, engines, invented by cunning men, to be on the towers and upon the bulwarks, to shoot arrows and great stones withal. Corn-mills were early invented; for we read in Deuteronomy, that it was not lawful for any man to take the nether or the upper mill-stone to pledge; yet water was not applied to mills before the year of Christ 600, nor wind-mills used before the year 1200. Likewise, 580 years before Christ, we read in Jeremiah xviii. of the potter's wheel. Architas was the first that applied mathematics to mechanics, but left no mechanical writings behind him: he made a wooden pigeon that could fly about. Archimedes, who lived about 200 years before Christ, was a most subtle geometer and mechanic. He made engines that drew up the ships of Marcellus at the siege of Syracuse; and others that would cast a stone of a prodigious weight to a great distance, or else several lesser stones, as also darts and arrows; but there have been many fabulous reports concerning these engines. He also made a sphere which showed the motions of the sun, moon, and planets. And Posidonius, afterwards, made another which showed the same thing. In these days, the liberal arts flourished, and learning met with proper encouragement; but, afterwards, they became neglected for a long time. Aristotle, who lived about two hundred and ninety years before Christ, was one of the first that writ any methodical discourse of mechanics. But, at this time, the art was contained in a very little compass, there being scarce any thing more known about it than the six mechanical powers. In this state, it continued till the sixteenth century, and then clockwork was invented; and, about 1650, were the first clocks made. At this time, several of the most eminent mathematicians began to consider mechanics; and, by their study and industry, have prodigiously enlarged its bounds, and made it a most comprehensive science. It extends through heaven and earth; the whole universe, and every part of it, is its subject. Not one particle of matter but what comes under its laws. For what else is there in the visible world, but matter and motion? and the properties and affections of both these are the subject of mechanics.—[Emerson.]

The Trial Chronometers at the Royal Observatory. [From the London Nautical Magazine.]

One of the first objects of peace in all civilized countries is the advancement of the arts and sciences; and of the numerous acquisitions which they have made in England during the last few years, the perfection of the chronometer is not the least important. The consequence and value of this machine to a country so "essentially maritime" as Great Britain, has justly obtained it the attention and patronage of Government; and for the last ten years its improvement has become the object of national reward. In fact, the sum of £500 has been annually expended with this design, in the purchase of the best chronometers that the country can produce. Previous to the year 1828 that sum had been divided into £300 and £200, for the purchase of the two best chronometers; but since that time it has been distributed among the three best, in the proportion of £200,

£170, and £130, according to their respective qualities. We shall see that this measure has been attended with salutary effect, for, while it has encouraged the art of constructing the chronometer, it has secured the best of them for the use of the Royal Navy. It has also excited an honorable competition, which has been the means of bringing them to their present perfect condition : one which, until some fresh discovery takes place in their construction, does not seem likely to be surpassed. Another good effect has attended this measure on the part of government. Until the establishment of trial chronometers at the Royal Observatory, the public had no criterion to guide them in deciding on their merits, and consequently their proportional value. Until the absolute daily rates were published in their regular monthly forms, as they are found by comparison at the Observatory, the dark ages of the chronometer may be said to have prevailed : for a veil of darkness hung over the performance of this invaluable machine, and all was uncertainty and conjecture respecting it. The fame of a solitary one now and then broke through this spell, and we heard of its making the land to a mile ; but this was considered a *rara avis*, and the owner of it fortunate in his possession. Even Government knew nothing about it, for it was not satisfactorily established what constituted a good chronometer. But, by the rigid trial which they undergo, the good were soon distinguished from the bad, and the state of the art in this country was quickly ascertained.

In 1822 the system of the trial chronometers at the Royal Observatory was established, and in order to ascertain the condition of the art, a reward of £300 and £200 was offered by the legislature for the two best chronometers. Notice was published, that any chronometers might be sent to the Royal Observatory, on trial, for the reward, provided that they were the property of the depositor, and that he was a chronometer maker by profession. As might be expected, chronometers rushed in from every quarter ; for, on referring to the printed monthly reports of the Observatory, we find no less than thirty-one were deposited ; and it is to be presumed, that those who sent them were their makers, whose names they severally bore.

The result of the first trial was, that, according to the method of deciding on their qualities, the trial number of one, Barraud's, No. 957, was 11,29 seconds, while that of Pennington, 155, was 12,87 seconds : results very different from those of the present day, but sufficient to show the condition of the art.

We will here take the opportunity of showing the method by which the merits of a chronometer are decided by what is termed its trial number : a method which we believe was proposed by the late Dr. Young, being the result of an extensive mathematical reasoning.

The trial number is derived from the following formula ; and the superiority assigned, accordingly, to the smallness of this number.

Put R=the greatest *mean monthly* rate, per diem.
r=the least do. do.
R'=the greatest daily rate in each month.
r'=the least do. do.
n=No. of months trial.

Make $(R'-r')=z$

And put z, z', z'', z''', &c., for each successive month. The Trial No. then is

$$2(R-r)+\frac{1}{n}\times(z, z', z'', z''',) \&c.$$

$$=2(R-r)+\frac{\Sigma(R'-r')}{n} \text{ where } \Sigma \text{ denotes the successive sums of } z, z', z'' \&c.$$

That is, by taking the difference of the greater and lesser mean monthly rate, and multiplying the same by 2, and adding thereto the mean of the monthly extreme variations.

EXAMPLE.

		Mean Rate.	Extreme Variation.
1830,	October	—0s69	0s9
	November	—0,54	2,1
	December	—0,85	2,0
1831,	January	—0,67	1,8
	February	—0,58	1,1
	March	—0,54	1,1
	April	—0,31	1,2
	May	—0,76	2,0
	June	—0,95	1,3
	July	—1,01	1,9
	August	—0,82	1,4
	September	—0,60	1,5
		Mean	1,53

Greater rate in July	1s,01
Lesser do. in April	0, 31
Difference	0, 70
Difference × 2	1, 40
Mean of Extreme Variation	1, 53
Trial Number	2, 93

Thus instituted, the annual trials proceeded regularly at the Observatory; and at the commencement of the 6th trial, in July, 1827, a notice was given, that "No chronometer is to be entitled to the first premium if the trial number shall exceed six seconds, nor to the second if the trial number shall

exceed ten seconds. This at once shows that it had been tolerably well ascertained what were the limits to be allowed to a good chronometer. We have seen that 11s,29 and 12s,87 had been the trial numbers of the two first best chronometers, and we now find it determined that six seconds was to be the trial number for the first prize; and that unless the second chronometer came within ten seconds, it was not to be entitled to a premium; both of which limits were within those of the best at the commencement.

In the trial of 1828, the distribution of the whole sum of £500, into three portions, took place in the manner we have before observed, and the trial numbers were respectively established as follows:

For the 1st premium of £200, not exceeding 5 seconds—2d, £170, not exceeding 6 seconds—3d, £130, not exceeding 7½; showing a reduction of one second in the trial number for the first premium—of four seconds in that for the second—and for the third, a number two and a half seconds less than that which had been first established for the second.

In November, 1831, at the commencement of the tenth annual trial, the limits of the trial numbers for obtaining the premiums were again reduced, and established as follows: For the 1st, not exceeding 3½ seconds—2d, not exceeding 4½ seconds—3d, not exceeding 6 seconds. Thus making the third rate chronometer as good as the second of the former trials; the trial number of the second within half a second of that of the first in the former trials; and the trial number of the first a second and a half less than the first of the preceding trials. This alone furnishes us with a tolerable criterion to judge of the state of the art in 1831, compared with what it was in 1821.

The tenth annual trial has just terminated, and we find a still further reduction in the trial numbers, which now stand as those established for the eleventh trial. They are as follows: For the 1st, not exceeding 2½ seconds—2d, not exceeding 3½ seconds—3d, not exceeding 4½ seconds; showing another reduction of one second on the two first, and a second and a half on the limits of the third trial number. It might be asked, can these limits be attained by a chronometer? To which we may reply, that they have been; and if the first should not be reached, Government will be no loser, as it will still have the best chronometer, and the maker will obtain a handsome reward.

We shall now lay before our readers the following table, showing the prize chronometers since the first establishment of the trials, the names of their makers, their trial numbers, and the number of chronometers deposited at the Observatory to compete for the prizes at the commencement, and the number left at the end, of each annual trial.

Year.	Premiums.	Makers' Names and Residences.	Number of Chronometer.	Trial Number.	Actual extreme variation in twelve months.	Extremes of Thermometer.	Number of Chronometers. Deposited for Trial.	Number of Chronometers. Left at the end of the Trial.
1823.	Fust	Mr. Barraud, Cornhill	957	11s29	3.86	25 to 80	31	18
	Second	Mr. Pennington, Camberwell	154	12.87	5.13			
1824.	First	Mr. Murray, Cornhill	816	4.44	1.11	34 to 70	36	18
	Second	Mr. Cathro, Kirby street, Hatton Garden	1512	6.84	1.88			
1825.	First	Mr. Widenham, East street, Red Lion square	929	5.44	1.80	36 to 70	31	9
	Second	Mr. French, Royal Exchange	1640	6.12	1.85			
1826.	First	Mr. French, Royal Exchange	20–3912	2.62	0.61	25 to 82	48	13
	Second		975	3.46	0.99			
1827.	First	Messrs. M'Cabe & Strachan, Cornhill	167	4.68	1.50	29 to 79	59	16
	Second	Mr. Young, Islington	78	5.65	2.00			
1828.	First	Mr. Guy, Radnor street, City road	1410	4.41	1.41	35 to 78	58	25
	Second	Mr. Young, Islington	85	4.52	1 23			
1829.	First	Mr. Dent, 43 King street, Long Acre	114	2.27	0.54	29 to 73	79	26
	Second	Mr. Carter, Tooley street	131	3.80	0.79			
	Third	Mr. Molyneux, 44 Devonshire st., Queen Sqr.	943	4.00	1.28			
1830.	First	Mr. Baker, 6 Angel Terrace, Pentonville	865	3.59	0.98	28 to 80	57	23
	Second	Mr. Carter, Tooley street	137	4.04	1.09			
	Third	Mr. Murray, Cornhill	640	4.34	1.13			
1831.	First	Mr. Cotterell, 163 Oxford street	311	2.93	0.70	27 to 78	73	29
	Second	Mr. Frodsham, Change Alley	2	3.65	0.86			
	Third	Mr. Webster, 43 Cornhill	665	3.73	0.89			
1832.	First	Mr. Molyneux	1038	2.82	0.67	39 to 78	62	23
	Second	Mr. Young	110	2.97	0.82			
	Third	Mr. Webster	695	3.09	0.86			

A glance at the foregoing table will show the truth of our observation on setting out—that a degree of perfection has been attained in the construction of the chronometer, which is not likely to be surpassed until some further discovery be made in it. This must be directed to the balance-spring, and what is termed the "compensation" in the balance-wheel, or the allowance for change of temperature, in which the whole art of chronometer-making now lies. Mr. Arnold's escapement has rendered that part of the construction as complete as can be desired at present, although it is said not to be adopted by our neighbors, the French; and his new lever compensation is a material improvement on those of the circular construction, although the latter display a depth of ingenuity, and acquaintance with the principles of the art, which can only result from many years' application to it.

Many ingenious and highly interesting experiments have been made on these parts of the chronometer, with the view of leading to some discovery respecting them—an account of which we hope to give our readers in some future numbers of our work. Mr. Arnold has already had twelve chronometers deposited at the Royal Observatory, during the last six months, for the purposes of experiment, by the permission of the Lords Commissioners of the Admiralty; and as a proof of his zeal for bringing the chronometer to perfection, he is anxious to place the sum of £100 in the hands of a public board, to be the reward of any *practical* maker who will simplify and improve the performance of the machine.

Memoir of the Life of Eli Whitney. [From the American Journal of Science and Arts.]

Eli Whitney was born in Westborough, Worcester county, Massachusetts, December 8, 1765. The paternal ancestors of Mr. Whitney emigrated from England among the early settlers of Massachusetts, and their descendants were among the most respectable farmers of Worcester county. His maternal ancestors, of the name of Fay, were also English emigrants, and ranked among the substantial yeomanry of Massachusetts. A family tradition respecting the occasion of their coming to this country may serve to illustrate the history of the times. The story is, that about two hundred years ago, the father of the family, who resided in England, a man of large property and great respectability, called together his five sons, and addressed them thus: "America is to be a great country: I am too old to emigrate to it myself, but, if any of you will go, I will give him a double share of my property." The youngest son instantly declared his willingness to go, and his brothers gave their consent. He soon set off for the New World, and landed at Boston, in the neighborhood of which place he purchased a large tract of land, where he enjoyed the satisfaction of receiving two visits from his venerable father.

Indications of Eli's mechanical genius were developed at a very early age. Of his early passion for such employments his sister gives the following account: "Our father had a work-shop, and sometimes made wheels of different kinds, and chairs. He had a variety of tools, and a lathe for turning chair-posts. This gave my brother an opportunity of learning the use of tools when very young. He lost no time, but as soon as he could handle tools he was always making something in the shop, and seemed not to like working on the farm. On a time, after the death of our mother, when our father had been absent from home two or three days, on his return he inquired of the housekeeper what the boys had been doing? She told him what B. and J. had been about. But what has Eli been doing? said he. She replied, he had been making a fiddle. 'Ah!' (added he despondingly,) 'I fear Eli will have to take his portion in fiddles.' He was at this time about twelve years old. His sister adds, that his fiddle was finished throughout, like a common violin, and made tolerably good music. It was examined by many persons, and all pronounced it to be a remarkable piece of work for such a boy to perform. From this time he was employed to repair violins, and had many nice jobs, which were always executed to the entire satisfaction, and often to the astonishment, of his customers. His father's watch being the greatest piece of mechanism that had yet presented itself to his observation, he was extremely desirous of examining its interior construction, but was not permitted to do so. On Sunday morning, observing that his father was going to meeting, and would leave at home the wonderful little machine, he immediately feigned illness as an apology for not going to church. As soon as the family were out of sight, he flew to the room where the watch hung, and, taking it down, he was so delighted with its motions, that he took it

all in pieces before he thought of the consequences of his rash deed; for his father was a stern parent, and punishment would have been the reward of his idle curiosity had the mischief been detected. He, however, put the work all so neatly together, that his father never discovered his audacity until he himself told him many years afterwards."

When Whitney was fifteen or sixteen years of age, he suggested to his father an enterprize which was an earnest of the similar undertakings in which he engaged on a far greater scale in later life. This being the time of the Revolutionary War, nails were in great demand, and bore a high price. At that period nails were made chiefly by hand, with little aid from machinery. Young Whitney proposed to his father to procure for him a few tools, and to permit him to set up the manufacture. His father consented, and he went steadily to work, and suffered nothing to divert him from his task until his day's work was completed. By extraordinary diligence he gained time to make tools for his own use, and to put in knife blades, and to perform many other curious little jobs, which exceeded the skill of the country artisans. At this laborious occupation the enterprising boy wrought alone, with great success, and with much profit to his father, for two winters—pursuing the ordinary labors of the farm during the summers. At this time he devised a plan for enlarging his business and increasing his profits. He whispered his scheme to his sister, with strong injunctions of secrecy; and requesting leave of his father to go to a neighboring town, without specifying his object, he set out on horseback in quest of a fellow laborer. Not finding one so easily as he had anticipated, he proceeded from town to town, with a perseverance which was always a strong trait of his character, until, at the distance of forty miles from home, he found such a workman as he desired. He also made his journey subservient to his improvement in mechanical skill, for he called at every workshop on his way, and gleaned all the information he could respecting the mechanic art.

At the close of the war the business of making nails was no longer profitable; but a fashion prevailing among the ladies of fastening on their bonnets with long pins, he contrived to make those with such skill and dexterity that he nearly monopolized the business, although he devoted to it only such seasons of leisure as he could redeem from the occupations of the farm, to which he now principally betook himself. He added to this article the manufacture of walking canes, which he made with peculiar neatness.

In respect to his proficiency in learning, while young, we are informed that he early manifested a fondness for figures, and an uncommon aptitude for arithmetical calculations, though, in the other rudiments of education, he was not particularly distinguished. Yet, at the age of fourteen he had acquired so much general information as to be regarded, on this account, as well as on account of his mechanical skill, as a very remarkable boy.

From the age of nineteen, young Whitney conceived the idea of obtaining a liberal education; but being warmly opposed by his step-mother, he was unable to procure the decided consent of his father until he had reached the age of twenty-three years But partly by the avails of his manual labor, and partly by teaching a village school, he had been so far able to surmount the obstacles thrown in his way, that he had prepared himself for the Freshman class in Yale College, which he entered in May, 1789. As we are soon to accompany Mr. Whitney beyond the sphere of his domestic relations, we may mention here that he finished his collegiate education with little expense to his father. His last college bills were indeed paid by him, but the money was considered as a loan, and for it the son gave his note, which he afterwards duly cancelled. After the decease of his father he took an active part in the settlement of his estate, but generously relinquished all his parsimony, for the benefit of the other members of the family.

The propensity of Mr. Whitney to mechanical inventions and occupations was frequently apparent during his residence at college. On a particular occasion, one of the tutors happening to mention some interesting philosophical experiment, regretted that he could not exhibit it to his pupils, because the apparatus was out of order, and must be sent abroad to be repaired. Mr. Whitney proposed to undertake this task, and performed it greatly to the satisfaction of the Faculty of the College.

A carpenter being at work upon one of the buildings of the gentleman with whom Mr. Whitney boarded, the latter begged permission to use his tools during the intervals of study; but the mechanic being a

man of careful habits, was unwilling to trust them with a student, and it was only after the gentleman of the house had become responsible for all damages, that he would grant the permission. But Mr. Whitney had no sooner commenced his operations than the carpenter was surprised at his dexterity, and exclaimed, "there was one good mechanic spoiled when you went to college."

Soon after Mr. Whitney took his degree, in the autumn of 1792, he entered into an engagement with a Mr. B. of Georgia, to reside in his family as a private teacher. Mr. Whitney had scarcely set his foot in Georgia, however, before he was met by a disappointment which was an earnest of that long series of adverse events which, with scarcely an exception, attended all his future negociations in the same State. On his arrival he was informed that Mr. B. had employed another teacher, leaving Whitney entirely without resources, and without friends, except in the family of General Greene, of Mulberry Grove, near Savannah, with whom he had accidentally formed an acquaintance in his journey into Georgia. In these benevolent people, however, his case excited much interest, and Mrs. Greene kindly said to him, 'My young friend, you propose studying the law; make my house your home—your room, your castle—and there pursue what studies you please.' He accordingly commenced the study of law under that hospitable roof.

Mrs. Greene was engaged in a piece of embroidery, in which she employed a peculiar kind of frame called a *tambour*. She complained that it was badly constructed, and that it tore the delicate threads of her work. Mr. Whitney, eager for an opportunity to oblige his hostess, set himself at work, and speedily produced a tambour frame made on a plan entirely new, which he presented to her. Mrs. Greene and her family were greatly delighted with it, and thought it a wonderful proof of ingenuity.

Not long afterwards, a large party of gentlemen came from Augusta and the upper county, to visit the family of Gen. Greene, consisting principally of officers who had served under the General in the Revolutionary army. Among the number were Major Bremen, Major Forsyth, and Major Pendleton. They fell into conversation upon the state of agriculture among them, and expressed great regret that there was no means of cleaning the green seed cotton, or separating it from its seed, since all the lands which were unsuitable for the cultivation of rice would yield large crops of cotton. But until ingenuity could devise some machine which would greatly facilitate the process of cleaning, it was in vain to think of raising cotton for market. Separating one pound of the clean staple from the seed was a day's work for a woman; but the time usually devoted to picking cotton was the evening, after the labor of the field was over. Then the slaves, men, women, and children, were collected in circles, with one, whose duty it was to rouse the dozing and quicken the indolent. While the company were engaged in this conversation, "Gentlemen," said Mrs. Greene, "apply to my young friend, Mr. Whitney—he can make any thing." Upon which she conducted them into a neighboring room, and showed them her tambour frame, and a number of toys which Mr. Whitney had made, or repaired, for the children. She then introduced the gentlemen to Whitney himself, extolling his genius, and commending him to their friendship. He modestly disclaimed all pretensions to mechanical genius; and when they named their object, he replied that he had never seen cotton or cotton seed in his life. Mrs. G. said to one of the gentlemen, "I have accomplished my aim. Mr. Whitney is a very deserving young man, and to bring him into notice was my object. The interest which our friends now feel for him, will, I hope, lead to his getting some employment to enable him to prosecute the study of the law."

But a new turn, that no one of the company dreamed of, had been given to Mr. Whitney's views. It being out of season for cotton in the seed, he went to Savannah, and searched among the warehouses and boats until he found a small parcel of it. This he carried home, and communicated his intentions to Mr. Miller, who warmly encouraged him, and assigned him a room in the basement of the house, where he set himself at work with such rude materials and instruments as a Georgia plantation afforded. With these resources, however, he made tools better suited to his purpose, and drew his own wire, (of which the teeth of the earliest gins were made,) an article which was not at that time to be found in the market of Savannah. Mrs. Greene and Mr. Miller were the only persons ever admitted to his work-shop, and the only persons who knew in what way he was employing himself. The many hours he spent in his mysterious pursuits afforded matter of great curiosity, and often of raillery, to the

younger members of the family. Near the close of the winter the machine was so nearly completed as to leave no doubt of its success.

Mrs. Greene was eager to communicate to her numerous friends the knowledge of this important invention, peculiarly important at that time, because then the market was glutted with all those articles which were suited to the climate and soil of Georgia, and nothing could be found to give occupation to the negroes, and support to the white inhabitants. This opened suddenly to the planters boundless resources of wealth, and rendered the occupations of the slaves less unhealthy and laborious than they had been before.

Mrs. Greene, therefore, invited to her house gentlemen from different parts of the State, and, on the first day after they had assembled, she conducted them to a temporary building, which had been erected for the machine, and they saw, with astonishment and delight, that more cotton could be separated from the seed in one day, by the labor of a single hand, than could be done in the usual manner in the space of many months.

The individual, however, who contributed most to incite Whitney to persevere in the undertaking was *Phineas Miller*, Esq. Mr. Miller was a native of Connecticut, and a graduate of Yale College. Like Mr. Whitney, soon after he had completed his education at college, he came to Georgia as a private teacher, in the family of General Greene, and after the decease of the General, he became the husband of Mrs. Greene. He had qualified himself for the profession of law, and was a gentleman of cultivated mind and superior talents; but he was of an ardent temperament, and therefore well fitted to enter with zeal into the views which the genius of his friend had laid open to him. He had also considerable funds at command, and proposed to Mr. Whitney to become his joint adventurer, and to be at the whole expense of maturing the invention until it should be patented. If the machine should succeed in its intended operation, the parties agreed, under legal formalities, "that the profits and advantages arising therefrom, as well as all privileges and emoluments to be derived from patenting, making, vending, and working the same, should be mutually and equally shared between them." This instrument bears date May 27, 1793, and immediately afterwards they commenced business under the firm of *Miller & Whitney*.

An invention so important to the agricultural interest (and, as it has proved, to every department of human industry,) could not long remain a secret. The knowledge of it soon spread through the State, and so great was the excitement on the subject, that multitudes of persons came from all quarters of the State to see the machine; but it was not deemed safe to gratify their curiosity until the patent right had been secured. But so determined were some of the populace to possess this treasure, that neither law nor justice could restrain them; they broke open the building by night and carried off the machine. In this way the public became possessed of the invention; and before Mr. Whitney could complete his model and secure his patent, a number of machines were in successful operation, constructed with some slight deviation from the original, with the hope of evading the penalty for violating the patent-right.

As soon as the copartnership of Miller & Whitney was formed, Mr. Whitney repaired to Connecticut, where, as far as possible, he was to perfect the machine, obtain a patent, and manufacture, and ship for Georgia, such a number of machines as would supply the demand.

His return to Georgia was, however, delayed until April. The importunity of Mr. Miller's letters, written during the preceding period, urging him to come on, evinces how eager the Georgia planters were to enter the new field of enterprize which the genius of Whitney had laid open to them.

"Do not let a deficiency of money, do not let any thing, (says Mr. Miller,) hinder the speedy construction of the Gins. The people of the country are almost running mad for them, and much can be said to justify their importunity."

The general resort of the planters to the cultivation of cotton, and its consequent production in vast quantities, the value of which depended entirely upon the chance of getting it cleaned by the gin, created great uneasiness, which first displayed itself in this pressure upon Miller and Whitney, and afterwards afforded great encouragement to marauders upon the patent right, who were now becoming numerous and audacious.

The *roller gin* was at first the most formidable competitor with Whitney's machine. It extricated the seeds by means of rollers, crushing them between revolving cylinders, instead of disengaging them by means of teeth. The fragments of seeds which remained in the cotton, rendered its execution

much inferior in this respect to Whitney's gin, and it was also much slower in its operation.

But a still more formidable rival appeared early in the year 1795, under the name of the *Saw Gin.* It was Whitney's gin, except that the teeth were cut in circular rims of iron, instead of being made of wires, as was the case in the earlier forms of the patent gin. The idea of such teeth had early occurred to Mr. Whitney, as he afterwards established by legal proof. But they would have been of no use except in connection with the other parts of his machine; and, therefore this was a palpable attempt to evade the patent right, and it was principally in reference to this that the law-suits were afterwards held.

In March, 1795, in the midst of these perplexities and discouragements, Mr. Whitney went to New-York on business, and was detained there three weeks by an attack of fever and ague, the seeds of which had been sown the previous season in Georgia. As soon as he was able to leave the house, he embarked on board a packet for New-Haven. On his arrival at this place, he was suffering under one of those chills which precede the fever. As was usual on the arrival of the packet, people came on board to welcome their friends, and to exchange salutations, when Mr. Whitney was informed that, on the preceding day, his shop, with all his machines and papers, had been consumed by fire. Thus suddenly was he reduced to absolute bankruptcy, having debts to the amount of four thousand dollars, without any means of making payment. Mr. Whitney, however, had not a spirit to despond under difficulties and disappointments, but was aroused by them to still more vigorous efforts.

Mr. Miller also, on hearing of this catastrophe, manifested a kindred spirit. The letters written by Mr. Whitney on the occasion we have not been able to obtain; but the reply of Mr. Miller indicates what were the feelings of both parties. It may be of service to enterprising young men, who meet with misfortunes, to read an extract or two:

"I think with you (says Mr. M.), that we ought to meet such events with equanimity. We have been pursuing a valuable object by honorable means; and I trust that all our measures have been such as reason and virtue must justify. It has pleased Providence to postpone the attainment of this object. In the midst of the reflections which your story has suggested, and with feelings keenly awake to the heavy, the extensive injury we have sustained, I feel a secret joy and satisfaction that you possess a mind in this respect similar to my own—that you are not disheartened—that you do not relinquish the pursuit—and that you will persevere and endeavor, at all events, to attain the main object. This is exactly consonant to my own determinations. I will devote all my time, all my thoughts, all my exertions, and all the money I can earn or borrow, to encompass and complete the business we have undertaken; and if fortune should, by any future disaster, deny us the boon we ask, we will at least deserve it. It shall never be said that we have lost an object which a little perseverance could have attained. I think, indeed, it will be very extraordinary, if two young men in the prime of life, with some share of ingenuity, with a little knowledge of the world, a great deal of industry, and a considerable command of property, should not be able to sustain such a stroke of misfortunes as this, heavy as it is."

While struggling with these multiplied misfortunes, intelligence was received from England, which threatened to give a final blow to all their hopes. It was, that the English manufacturers condemned the cotton cleaned by their machines, on the ground that the staple was greatly injured.

At this time (1796) Miller and Whitney had thirty gins at eight different places in the State of Georgia, some of which were carried by horses or oxen, and some by water. A number of these were standing still for want of the means of supplying them. The company had also invested about $10,000 in real estate, which was suited only to the purposes of ginning cotton. All things now conspired to threaten them with deep insolvency.

We have before us a letter written by Mr. Whitney, dated Oct. 7th, 1797, from which it will be seen what was the state of his affairs, and of his feelings, at this period: "The extreme embarrassments (says he) which have been for a long time accumulating upon me, are now become so great that it will be impossible for me to struggle against them many days longer. It has required my utmost exertions to exist, without making the least progress in our business. I have labored hard against the strong current of disappointment, which has been threatening to carry us down the cataract, but I have labored with a shattered oar, and struggled in vain, unless some speedy relief is obtained."

However, brighter prospects seemed now to be opening upon them, from the more favorable reports that were made respecting the quality of their cotton. Respectable manufacturers, both at home and abroad, gave favorable certificates; and retailing merchants sought for the cotton cleaned by Whitney's gin, because it was greatly preferred by their customers to any other in the market. This favorable turn in public opinion would have restored prosperity to the company, had not the encroachments on their patent right become so extensive as almost to annihilate its value.

In April, 1799, Mr. Miller writes as follows: "The prospect of making any thing by ginning in this State is at an end. Surreptitious gins are erected in every part of the country; and the jurymen at Augusta have come to an understanding among themselves, that they will never give a cause in our favor, let the merits of the case be as they may."

Many of the planters of South Carolina having expressed an opinion, that, if an application were made to their legislature by the citizens to purchase the right of the patentees for that State, there was no doubt that it would be done to the satisfaction of all parties. Accordingly Mr. Whitney repaired to Columbia, taking the city of Washington in his way, where he was furnished with very obliging letters from President Jefferson and Mr. Madison, then Secretary of State: testimonials which, no doubt, were of great service to him in his subsequent negociations. Soon after the opening of the session of the legislature in the month of December, 1801, the business was regularly brought before the legislature, and a joint committee of both Houses appointed to treat with the patentees.

We subjoin an extract of a letter addressed at this time by Mr. Whitney to his friend Stebbins, both as a statement of the particulars relating to the contract, and as evincive of the feelings of the writer:

"Columbia, S. C., Dec. 20, 1801.

"Dear Stebbins,—I have been at this place a little more than two weeks, attending the legislature. They closed their session at ten o'clock last evening. A few hours previous to their adjournment, they voted to purchase, for the State of South Carolina, my patent right to the machine for cleaning cotton at fifty thousand dollars, of which sum twenty thousand is to be paid in hand, and the remainder in three annual payments of ten thousand dollars each. This is selling the right at a great sacrifice. If a regular course of law had been pursued, from two to three hundred thousand dollars would undoubtedly have been recovered. The use of the machine here is amazingly extensive, and the value of it beyond all calculation. It may, without exaggeration, be said to have raised the value of seven-eighths of all the three southern States from fifty to one hundred per cent. We get but a song for it in comparison with the worth of the thing; but it is securing something. It will enable Miller and Whitney to pay all their debts, and divide something between them. It establishes a precedent, which will be valuable as it respects our collections in other States, and I think there is now a fair prospect that I shall in the event realize property enough to render me comfortable, and in some measure independent."

In December, 1802, Mr. Whitney negociated a sale of his patent right with the State of North Carolina. The legislature laid a tax of two shillings and sixpence upon every saw* employed in ginning cotton, to be continued for five years, which sum was to be collected by the sheriffs in the same manner as the public taxes; and after deducting the expenses of collection, the avails were faithfully paid over to the patentee. At that time the culture of cotton had made comparatively little progress in the State of North Carolina, but in proportion to the amount of interest concerned, this compensation was regarded by Mr. Whitney as more liberal than that received from any other source.

While these encouraging prospects were rising in North Carolina, Mr. Goodrich, an agent of the company, was entering into a similar negociation with the State of Tennessee. The importance of the machine began to be universally acknowledged in that State, and various public meetings of the citizens were held, in which were adopted resolutions strongly in favor of a public contract with Miller and Whitney. Accordingly the legislature of Tennessee, at their session in 1804, passed an act laying a tax of thirty-seven and a half cents per annum on every saw for the period of four years.

But while a fairer day seemed dawning upon the company in this quarter, an unexpected and threatening cloud was rising in another. It was during Mr. Whitney's negociation with the legislature of North Carolina that he received intelligence that the

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* Some of the gins had forty saws.

legislature of South Carolina had annulled the contract made with Miller and Whitney the preceding year, had suspended payment of the balance (thirty thousand dollars) due them, and instituted a suit for the recovery of what had already been paid to them.

The ostensible causes of this extraordinary measure, adopted by the legislature of South Carolina, were a distrust of the validity of the patent right, and failure on the part of the patentees to perform certain conditions agreed on in the contract. Great exertions had constantly been made in Georgia to impress the public with the notion that Mr. Whitney was not the original inventor of the cotton gin, somebody in Switzerland having conceived the idea of it before him; and especially that he was not entitled to the credit of the invention in its improved form, in which saws were used instead of wire teeth, inasmuch as his particular form of the machine was introduced by one Hodgin Holmes. It was on these grounds that the Governor of Georgia, in his message to the legislature of that State in 1803, urged the inexpediency of granting any thing to Miller and Whitney.

Popular feeling, stimulated by the most sordid motives, was now awakened throughout all the cotton-growing States. Tennessee followed the example of South Carolina in suspending the payment of the tax laid upon cotton gins, and a similar attempt was made at a subsequent session of the legislature of North Carolina, but it wholly failed, and the report of a committee offering a resolution, that "the contract ought to be fulfilled with punctuality and good faith," was adopted by both branches of the legislature.

There were also high minded men in South Carolina, who were indignant at the dishonorable measures adopted by their legislature of 1803, and their sentiments had impressed the community so favorably with regard to Mr. Whitney, that at the session of 1804 the legislature not only rescinded what the previous legislature had done, but signified their respect for Mr. Whitney by marked commendations.

At this time a new and unexpected responsibility devolved on Mr. Whitney, in consequence of the death of his partner, Mr. Miller, who died on the 7th December, 1803.

Mr. Whitney was now left alone to contend singly against those difficulties which had for a series of years almost broken down the spirits of both the partners. But the favorable issue of the affairs of Mr. Whitney in South Carolina during the subsequent year, and the generous receipts that he obtained from the avails of his contracts with North Carolina, relieved him from the embarrassments under which he had so long groaned, and made him in some degree independent. Still, no small portion of the funds thus collected in North and South Carolina was expended in carrying on the fruitless, endless law-suits in Georgia.

In the United States Court, held in Georgia in December, 1807, Mr. Whitney obtained a most important judgment, in a suit brought against a trespasser of the name of Fort. It was on this trial that Judge Johnson gave the decision in his favor, to which we have before alluded.

This favorable decision, however, did not put a final step to aggression. At the next session of the United States Court, two other actions were brought, and verdicts for damages gained, of two thousand dollars in one case, and one thousand and five hundred dollars in the other.

The influence of these decisions, however, availed Mr. Whitney very little, for now the term of his patent right was nearly expired. More than sixty suits had been instituted in Georgia before a single decision on the merits of his claims was obtained, and at the period of this decision, thirteen years of his patent had expired.

In 1798, Mr. Whitney became deeply impressed with the uncertainty of all his hopes founded upon the cotton gin, notwithstanding their high promise, and he began to think seriously of devoting himself to some business in which superior ingenuity, seconded by uncommon industry, qualifications which he must have been conscious of possessing in no ordinary degree, would conduct him by a slow but sure route to a competent fortune; and we have always considered it indicative of a solid judgment, and a well balanced mind, that he did not, as is frequently the case with men of inventive genius, become so poisoned with the hope of vast and sudden wealth as to be disqualified for making a reasonable provision for life, by the sober earnings of frugal industry.

The enterprize which he selected in accordance with these views was the manufacture of arms for the United States. He accordingly addressed a letter to the Hon. Oliver Wolcott, Secretary of the Treasury, and through his influence obtained a contract for ten thousand stand of arms, amounting (as the price of each musket was to be thirteen dollars and forty cents) to one hundred

and thirty-four thousand dollars—an undertaking of great responsibility, considering the limited pecuniary resources of the undertaker. This contract was concluded on the 14th of January, 1798, and four thousand were to be delivered on or before the last day of September of the ensuing year, and the remaining six thousand within one year from that time, so that the whole contract was to be fulfilled within a little more than the period of two years: and for the due fulfilment of it, Mr. Whitney entered into bonds to the amount of thirty thousand dollars. He must have engaged in this undertaking resolved "to attempt great things," without stopping to weigh all the chances against him, for as yet the works were all to be erected, the machinery to be made, and much of it to be invented; the raw materials were to be collected from different quarters, and the workmen themselves, almost without exception, were yet to learn the trade. Nor was it a business with which Mr. Whitney himself was particularly conversant. Mechanical invention, a sound judgment, and persevering industry, were all that he possessed, at first, for the accomplishment of an enterprize which was, at that time, probably greater than any man had ever undertaken in the State of Connecticut.

The site which Mr. Whitney had purchased for his works was at the foot of the celebrated precipice called East Rock, within two miles of New-Haven. This spot, (which is now called Whitneyville), is justly admired for the romantic beauty of its scenery. A waterfall of moderate extent afforded here the necessary power for propelling the machinery. In this pleasant retreat Mr. Whitney commenced his operations with the greatest zeal; but he soon became sensible of the multiplied difficulties which he had to contend with. A winter of uncommon severity set in early, and suspended his labors; and when the spring returned, he found himself so little advanced that he foresaw that he should be utterly unable to deliver the four thousand muskets according to contract. At the end of the first year after the contract was made, instead of four thousand muskets, only five hundred were delivered, and it was eight years, instead of two, before the whole ten thousand were completed. The entire business relating to the contract was not closed until January, 1809, when (so liberally had the government made advances to the contractor) the final balance due to Mr. Whitney was only 2,450 dollars.

In the year 1812, he entered into a new contract with the United States to manufacture for them fifteen thousand stand of arms; and in the mean time he executed a similar engagement (we know not how extensive) for the State of New-York.

It should be remarked, that the utility of Mr. Whitney's labors, during the period of his life which we have now been contemplating, was not limited to the particular business in which he was engaged. Many of the inventions which he made to facilitate the manufacture of muskets, were applicable to most other manufactures of iron and steel. To many of these they were soon extended, and became the nucleus around which other inventions clustered; and at the present time some of them may be recognized in almost every considerable workshop of that description in the United States.

In the year 1812, Mr. W. made application to Congress for the renewal of his patent for the cotton gin. In his memorial he presented a history of the struggles he had been forced to encounter in defence of his right, observing that he had been unable to obtain any decision on the merits of his claim until he had been *eleven years* in the law, and *thirteen years* of his patent term had expired. He set forth, that his invention had been a source of opulence to thousands of the citizens of the United States; that, as a labor-saving machine, it would enable one man to perform the work of a thousand men; and that it furnishes to the whole family of mankind, at a very cheap rate, the most essential article of their clothing. Hence, he humbly conceived himself entitled to a further remuneration from his country, and thought he ought to be admitted to a more liberal participation with his fellow citizens in the benefits of his invention. Although so great advantages had been already experienced, and the prospect of future benefits was so promising, still, many of those whose interest had been most promoted, and the value of whose property had been most enhanced, by this invention, had obstinately persisted in refusing to make any compensation to the inventor. The very men whose wealth had been acquired by the use of this machine, and who had grown rich beyond all former example, had combined their exertions to prevent the patentee from deriving any emolument from his invention. From that State, in which he had first made and where he had first introduced his machine, and which had derived the most signal bene-

fits from it, he had received nothing; and from one State had he received the amount of *half a cent per pound* on the cotton cleaned with his machines in one year. Estimating the value of the labor of one man at twenty cents per day, the whole amount which had been received by him, for his invention, was not equal to the value of the labor saved *in one hour* by his machines then in use in the United States.

Notwithstanding these cogent arguments, the application was rejected by Congress. Some liberal minded and enlightened men from the cotton districts favored the petition; but a majority of the members from that section of the Union were warmly opposed to granting it.

In the midst of these fruitless efforts to secure to himself some portion of the advantages which so many of his fellow citizens were reaping from his ingenuity, his armory proceeded with a sure but steady pace, which bore him on to affluence. For the few following years he occupied himself principally in the concerns of his manufactory, inventing new kinds of machinery, and improving and perfecting the old.

In January, 1817, Mr. Whitney was married to Miss Henrietta F. Edwards, youngest daughter of the honorable Pierpont Edwards, late Judge of the District Court for the State of Connecticut. The fond and quiet scenes of domestic life, after which he had long aspired, but from which he had been debarred by the embarrassed or unsettled state of his affairs, now spread before him in the fairest light. Four children, a son and three daughters, added successively fresh attractions to the family circle. Happy in his home, and easy in his fortune, with a measure of respectability among his fellow citizens, and celebrity abroad, which might well satisfy an honorable ambition, he seemed to have in prospect, after a day of anxiety and toil, an evening unusually bright and serene.

In this uniform and happy tenor, he passed the five following years, when a formidable malady began to make its approaches, by a slow but hopeless progress, which at length terminated his life.

From the 12th November, 1824, his sufferings became almost unremitted, until the 8th January, 1825, when he expired,—retaining his consciousness to the last, closing his own eyes, and making an effort to close his mouth.

In his person, Mr. Whitney was considerably above the ordinary size, of a dignified carriage, and of an open, manly and agreeable countenance. His manners were conciliatory, and his whole appearance such as to inspire universal respect. Among his particular friends no man was more esteemed. Some of the earliest of his intimate associates were also among the latest. With one or two of the bosom friends of his youth he kept up a correspondence by letter for thirty years, with marks of continually increasing regard. His sense of honor was high, and his feelings of resentment and indignation occasionally strong. He could, however, be cool when his opponents were heated; and though sometimes surprized by passion, yet the unparalleled trials of patience which he had sustained did not render him petulant, nor did his strong sense of the injuries he had suffered in relation to the cotton gin impair the natural serenity of his temper.

But the most remarkable trait in the character of Mr. Whitney, aside from his inventive powers, was his *perseverance;* and this is the more remarkable, because it is so common to find men of great powers of mechanical invention defective in this quality. Nothing is more frequent than to see a man of the most fertile powers of invention run from one piece of mechanism to another, leaving the former half finished; or if he has completed any thing, it is usual to find him abandon it to others, too fickle to pursue the advantages he might reap from it, or too sensitive to struggle with the sordid and avaricious, who may seek to rob him of the profits of his invention.

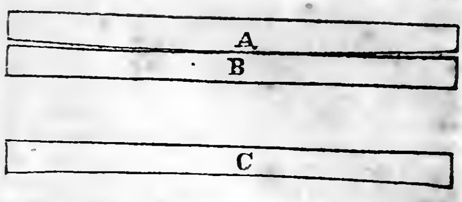
It would be difficult to estimate the full value of Mr. Whitney's labors without going into a minuteness of detail inconsistent with our limits. Every cotton garment bears the impress of his genius, and the ships that transported it across the waters were the heralds of his fame; and the cities that have risen to opulence by the cotton trade must attribute no small share of their prosperity to the inventor of the cotton gin. We have before us the declaration of the late Mr. Fulton, that Arkwright, Watt, and Whitney, (we could add Fulton to the number), were the three men who did most for mankind of any of their contemporaries; and, in the sense in which he intended it, the remark is probably true.

The following observations of a distinguished scholar and statesman, elicited in consequence of a recent visit to the cemetery of New-Haven, evince the estimation in which Mr. Whitney's name is held, by one who is fully capable of appreciating his merits. After alluding to the monument of

Gen. Humphreys, who introduced the fine woolled sheep into the United States, the stranger remarks: "But Whitney's monument perpetuates the name of a still greater public benefactor. His simple name would have been epitaph enough, with the addition, perhaps, of 'the inventor of the cotton gin.' How few of the inscriptions in Westminster Abbey could be compared with that! Who is there that, like him, has given his country a machine—the product of his own skill—which has furnished a large part of its population, 'from childhood to age, with a lucrative employment: by which their debts have been paid off; their capitals increased; *their lands trebled in value.*' It may be said, indeed, that this belongs to the physical and material nature of man, and ought not to be compared with what has been done by the intellectual benefactors of mankind—the Miltons, the Shakspeares, and the Newtons. But it is quite certain that any thing short of the highest intellectual vigor—the brightest genius—is sufficient to invent one of these extraordinary machines. Place a common mind before an oration of Cicero and a steam engine, and it will despair of rivalling the latter as much as the former; and we can by no means be persuaded, that the peculiar aptitude for combining and applying the simple powers of mechanics so as to produce these marvellous operations, does not imply a vivacity of the imagination, not inferior to that of the poet and the orator. And then, as to the effect on society, the machine, it is true, operates, in the first instance, on mere physical elements, to produce an accumulation and distribution of property. But do not all the arts of civilization follow in the train? and has not he, who has trebled the value of land, created capital, rescued the population from the necessity of emigrating, and covered a waste with plenty—has not he done a service to the country, of the highest moral and intellectual character? Prosperity is the parent of civilization, and all its refinements; and every family of prosperous citizens added to the community, is an addition of so many thinking, inventing, moral, and immortal natures."

On Mr. Whitney's tomb is the following inscription:

ELI WHITNEY,
The inventor of the Cotton Gin.
Of useful science and arts, the efficient
patron and improver.
In the social relations of life, a model of excellence.
While private affection weeps at his tomb,
his country honors his memory.
Born December 8, 1765.—Died January 8, 1825.



STRAIGHT EDGES.—Among mechanics there are probably but few who do not appreciate the value of a good straight edge for ascertaining the correctness of their work, and I presume that a description of the method practised, and the theory upon which it is based, will be interesting. There are doubtless many that like myself have thought it absurd, even when told seriously, by good practical workmen, that it was impossible to make *one* straight edge, without making *three*, or that one plate of an air-pump could not be ground flat, unless three were ground at the same time.

When I inquired the reason of this, I could get no other explanation from my informant than that such was the fact. Although at that time I considered the idea ridiculous, I have since discovered that my friend was perfectly correct, and, had he been able to have stated the cause or theory, I feel assured I should have been convinced.

I am aware, in the formation of straight edges, that the size must depend much upon the work to which it is to be applied, yet some regard to the form and dimensions are advisable, as there is a certain proportion more suitable than any other. An eminent English writer (Dr. Birkbeck) observes upon this subject, that in England they are made of thin bars of steel, about one eighth of an inch thick, two inches broad, and should not exceed three feet in length, as they will otherwise be liable to bend.

Three such pieces should be prepared by planishing, and one edge of each made as straight as possible by the common means of filing and planing, when they are perfected by grinding them mutually with each other, fine emery and oil being added to assist the operation. They are finally to be finished with crocus martus, or a species of loam well washed, to separate it from any coarse siliceous particles.

By referring to the cut at the head of our article, we will attempt to show the necessity of making three, to produce one perfect straight edge, and also of repeatedly changing them at proper intervals until each edge is correct. Let A and B represent two steel

bars prepared for grinding; let us then suppose the edge of A to be slightly convex, and that of B slightly concave, or nearly straight, then by grinding A and B together the two edges will meet, but will not be straight, because the convex bar A has ground the lower bar B more concave, and although the two edges come in close contact, yet the form is unchanged, and, however long the grinding should be continued, the object could never be attained.

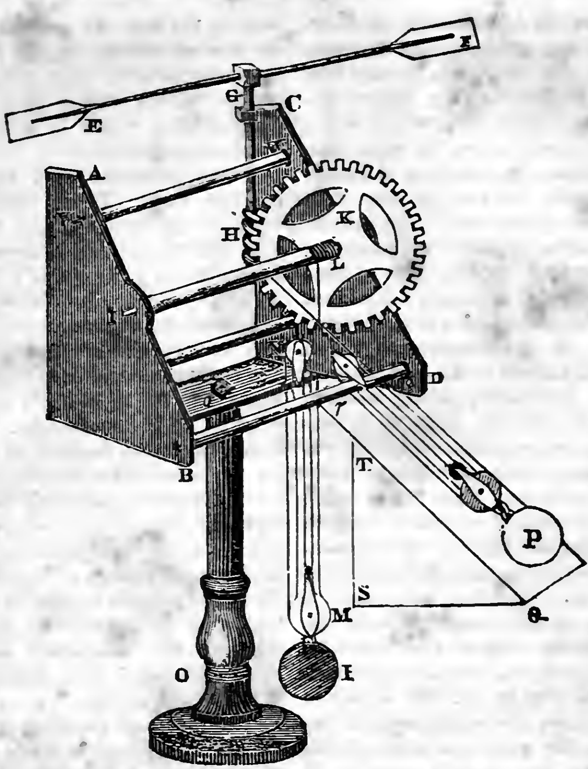
But if we now take a third bar C, the edge of which may be either concave or convex; if concave, and we grind A and C together, the edges of B and C will then be similar, and if placed against one another, the difference will be doubled, and can readily be perceived; these two are then to be ground together, and thus the three edges being alternately and reciprocally ground together, they will mutually cut down and destroy each other's imperfections, and a perfect straight edge will ultimately be produced on all the three.

The same theory applies to the levelling of air-pump plates, and other flat surfaces in machinery where great nicety is required, and the best method of producing them is to proceed in the manner above described.—[Young Mechanic.]

The Walthamstow Wooden Spoon Maker.—I lately happened to meet with a very old and intelligent individual, in the neighborhood of Walthamstow, who was represented to me by his daughter as being no scholar, and who found it convenient to employ his evenings in making one single article—wooden spoons. Every evening in the year, when the evenings were long, he sat down, and with very few tools—a couple of gouges, a plain chisel, a bad file, and two or three knives—he sat down and constructed four spoons every evening, which he formed in a somewhat beautiful manner. You see to what a degree of perfection a mono-mechanic—a man who makes but one thing—can attain by directing his attention simply to the making of spoons. The old artist constructed them of different kinds of wood, all of our own country—some of the plum-tree, the barberry, (which in day-light is very beautiful,) and the pear-tree, and the cherry-tree. He makes four spoons every evening, which he sells at three pence each; and is visited every evening by many persons in consequence of these productions: (they are exceedingly convenient little spoons for tea-caddies, sugar-basins, and so on,) and he feels himself that it is better to make a spoon than to be idle, and that, if he were not sitting still making spoons, he might be sitting somewhere making mischief. He is besides a man of considerable natural taste: he is an entomologist, a butterfly-catcher—but he understands nothing more about them than their commmon names; yet he arranges them very beautifully: he has a very pretty cabinet of butterflies, and moths, and insects, and in the day-time is engaged in that pursuit. He entertains himself likewise in a garden, enjoys delightful health and spirits, and is a very interesting picture of a happy old man.—[Dr. Birkbeck.]

Blacking.—"A Subscriber" asks for a receipt for making blacking, "as his family is numerous, and purchasing at 18d. per bottle is more than he can well afford." We subjoin one which is given in the Annales de Chimie, by the celebrated French chemist Braconot, who pronounces it to be, as compared with all the other known blackings, from Day's to Hunt's, "undoubtedly the cheapest and the best." Macerate one pound of malt in boiling water till every thing soluble is taken up, add $2\frac{1}{4}$ lbs. of plaster of paris well sifted, and 7 ozs. of lamp-black; then evaporate to the consistence of paste; and finally mix up with 1 lb. 2 ozs. of olive oil. It is said to spread very evenly, dry speedily, and shine brilliantly, with very little brushing; while it neither burns nor injures the leather.—[London M. Mag.]

Steam Boiler Deposits.—*Institution of Civil Engineers, April* 3.—In the case of the saline deposition, which accumulates in boilers during sea-voyages, it was mentioned as the usual practice merely to blow off a portion of water from the boiler, according as it becomes saturated. In short voyages of three or four days, this is found sufficient for the purpose; but for vessels crossing the Atlantic, or on other long voyages, a more efficient plan has been resorted to, by attaching an apparatus to the engine which pumps out brine from the bottom of the boiler, at the same time throwing in a quantity of clear water equal to what is abstracted. The degree of saturation is indicated by means of an attached thermometer: 218 degrees Fahr. being the boiling point of clean sea water in a steam engine boiler, a range is allowed from that to 227 degrees, which marks the limit of saturation admissible for a steam boiler to be worked with safety.—[Ath.]



A Machine in which all the Mechanical Powers are united.—The preceding figure represents a machine in which all the simple mechanical powers are combined.

It consists of a frame A B C D, fastened upon the stand O *o* by the nut *o*, and kept together by the pillars V W and B *q*. The piece E F is first fitted to the frame, having vanes, E F, which may be either moved by the wind, or by a cord fastened at F. This part represents the lever, whose fulcrum is G. A perpendicular axis G A is joined to this lever, and carries the endless screw H, which may be considered as a wedge. This endless screw works in the teeth of the wheel K, which is the wheel and axle; and when K is turned round, it winds upon the axle I L the cord L M, which, passing round the tackle of pulleys M N, raises the weight P. In order to include the inclined plane in this combination, we must add the plane R Q *r q*, and make it rest on the ground at Q R, and on the pillar B *q* at *q r*. When the weight P is placed on this plane, the power will be farther increased in the ratio of Q T to T S. The power gained by this combination will be found, by comparing the space described by the point F with the height through which the weight rises in any determinate number of revolutions of F.

Decimal Fractions.—We now proceed to explain the species of fractions which are called *decimal*, a word derived from the Latin *decem*, ten. In doing this it will be necessary to enter upon the decimal system generally, and to point out the features which distinguish our arithmetic from that of ancient times. The Greeks and Romans reckoned as we do, by tens; that is to say, having given names to the first ten numbers, they made these names serve to reckon all numbers as far as ten tens, or one hundred, for which a new name was introduced; with this they proceeded as far as ten hundreds, or one thousand, where again a new name was adopted. In the symbols by which they represented numbers, they were not fortunate; and the Roman method especially, which is often used amongst us, is so clumsy as to make it no matter of wonder why that people never cultivated arithmetic with success. Our method came originally from India through the Moors, who brought it into

Spain. It enables us to represent all numbers by means of ten symbols, one denoting nothing, and the rest standing for the first nine numbers. The value of a figure depends not only upon the number which it represents, when it stands alone, but also upon the place or column in which it is found. Thus, in 2222 yards, the two on the right hand stands for two yards only; the next to it for 2 tens of yards, or twice ten yards, or twenty yards; the next for two tens of tens of yards, or two hundred yards; the next for two tens of hundreds of yards, or two thousand yards. It is necessary to recall this, which is well known to all our readers, and in which the superiority of the modern system consists, in order to show how simply fractions may be represented by an extension of the same method. In the number 11111, if we proceed from left to right, each unit is the tenth part of the one which preceded it. Thus the first one is ten thousand, the second one thousand, the third one hundred, and so on. The last 1 is simply a unit, which may, introducing fractions, be divided into ten parts, each of which will be one tenth of the unit, and will be represented in the common way by $\frac{1}{10}$. If we would carry on the notation just explained, in the case of 11111, we may place one more unit on the right and agree that it shall stand for $\frac{1}{10}$ of the unit. This would give 11111 1, in which the separation is made to avoid confounding this, which is eleven thousand one hundred and eleven yards and one-tenth of a yard, with 111111, which is one hundred and eleven thousand one hundred and eleven yards. In the same way in 11111 1111, the first 1 after the unit's place, or the first which is separated from the rest, stands for one-tenth of a yard, the second for one-tenth of a tenth, or one-hundredth of a yard, the third for a tenth of a hundred of a yard or one-thousandth of a yard, and the fourth for one-tenth of a thousandth, or one-ten-thousandth part of a yard. Instead of a separation, it is usual to mark a point after the unit's place, and all figures which come before the point are whole yards, pounds, acres, &c., as the case may be, while all which come after the point are fractions of the same. Thus, 12·34 yards stands for 12 yards, 3 tenths of a yard, and 4 hundredths of a yard; ·768 stands for 7 tenths, 6 hundredths and 8 thousandths. The cipher is used in the same way as in whole numbers, viz. to keep each number in its proper place. Thus one-hundredth is distinguished from one-tenth by writing the first ·01, and the second ·1, since the second column on the right of the point is appropriated to hundredths, and the first to tenths. Thus ·308 is three tenths and eight *thousandths*; ·0308 is 3 hundredths and 8 ten thousandth parts.

These fractions may be represented in another way. Thus, ·123, which is one-tenth, 2 hundredths, and 3 thousandths, is also 123 thousandths, or one hundred and twenty-three parts out of a thousand. For if we divide the unit into 1000 parts, one-tenth is 100 of these parts, one hundredth is 10, and two hundredths are 20 of these parts, and three thousandths are three of these parts. Similarly ·76 is either 7 tenths and 6 hundredths, or 76 hundredths. The rule is: To write a decimal fraction in the common way, let the numerator be the number which follows the point, throwing away cyphers from the beginning if necessary; let the denominator be unity followed by as many ciphers as there are places of figures after the point. By the same rule a number and decimal fraction may be converted into one common fraction, the numerator being formed by throwing away the decimal point. Thus 7·12 is $7\frac{12}{100}$ or $\frac{712}{100}$.

The decimal point is always understood as coming after the unit's place, even when there are no fractions. Thus 16 is 16· or 16·000. And any number of ciphers may be placed after a decimal without altering its value. Thus ·4 and ·40 are the same, the first being 4 parts out of ten, and the second also 4 parts out of ten, or which is the same thing, 40 parts out of one hundred. No fraction can be converted into a decimal of *exactly* the same value, unless its denominator be either 5 or 2, or a product of some number of fives and twos, such as 250, which is the product of 5, 5, 5, and 2. For the changing a common into a decimal fraction is the finding a second fraction, equal in value to the first, and whose denominator shall be one of the series of *decimal* numbers, 10, 100, 1000, &c. There is only one way of altering the terms of a fraction without altering its value, viz. by multiplying or dividing both numerator and denominator by the same number. It will easily be found by experiment, and it is proved in books of algebra, that a *decimal* number, that is, a unit followed by ciphers, is not divisible by any number except it be either 2, 5, or a product of twos and fives. Hence it is impossible that a multiplier can be found for 7, for example, which shall make the product a decimal number

for i so, since the product is always divisible by the multiplicand, there would be a decimal number divisible by 7, which is impossible.

Hence there is no decimal fraction exactly equal to $\frac{1}{7}$, or $\frac{1}{9}$, or $\frac{1}{13}$, and so on. Nevertheless, a decimal fraction can be found as near as we please to any fraction whatever; that is, if we take $\frac{2}{13}$, and take any fraction as small as we please, for example, $\frac{1}{100000}$ or ·00001, we can find a decimal fraction which shall not differ from $\frac{2}{13}$ by so much as ·00001; and if we please, we can come still nearer than that small difference. Suppose it is required to find a decimal fraction which shall not differ from $\frac{2}{13}$ by so much as $\frac{1}{1000}$ or ·001. Multiply the numerator and denominator by 1000, which gives $\frac{2000}{13000}$. The numerator 2000, divided by 13, gives the quotient 153 and the remainder 11; so that both 2000 diminished by 11, and 2000 increased by two, are divisible by 13, that s, 1989 and 2002 are divisible by 13, and give the quotients 153 and 154. Of the three fractions $\frac{1989}{13000}$ $\frac{2000}{13000}$ and $\frac{2002}{13000}$, which have the same denominator, the first is the least, the third is the greatest, and the second lies between the first and third. But the first and third (dividing both numerator and denominator by 13) are $\frac{153}{1000}$ and $\frac{154}{1000}$ or ·153 and ·154, and the second is the same as $\frac{2}{13}$. The first and third differ from one another by $\frac{1}{1000}$ or ·001; hence the second, which lies between them, does not differ by so much as $\frac{1}{1000}$ from either. We have, therefore, two decimal fractions ·153 and ·154, the first a little less, and the second a little greater, than $\frac{2}{13}$, each within $\frac{1}{1000}$ of $\frac{2}{13}$. The rule derived from this process is—To find a decimal fraction which shall not differ from a common fraction by so much as $\frac{1}{1000}$, &c. annex as many ciphers to the numerator as there are ciphers in 1000, &c., divide by the denominator, and cut off by the decimal point from the quotient as many places as there were cyphers in 1000, &c., completing the number, if necessary, by adding cyphers to the left, and taking no account of the remainder. Thus $\frac{365}{18}$ is within $\frac{1}{1000000}$ of 20·277777.

The rules for addition, subtraction, multiplication and division, of decimal fractions, are very similar to those in whole numbers. In addition and subtraction the decimal points are to be placed under one another, which will bring units under units, tens under tens, tenths under tenths, &c. The process is then precisely the same as in whole numbers, the decimal point in the result being placed under the other points. In multiplication we must proceed to multiply as if there were no decimal points, and afterwards make as many decimal places in the result as were in both the multiplier and multiplicand. For the product of ·238 and ·112 or $\frac{238}{1000}$ and $\frac{112}{1000}$ is, by the common rule, $\frac{26656}{1000000}$: and as one decimal number is multiplied by another by forming a third decimal number, which shall have as many ciphers as both the former ones together, and since the number of ciphers in the denominator of a decimal fraction expressed in the common way is the number of places which it will have when the point is substituted for the denominator, the reason of the rule is evident. The product obtained above is ·026656 by the rule, one cipher being necessary to make up six places. It is moreover evident that $\frac{26656}{1000000}$ is less than ·1 or $\frac{1}{10}$, the latter being $\frac{100000}{1000000}$.

The rule for division of one decimal by another, as given in many books of arithmetic, is likely to mislead the student in various cases. From the following principles a rule may be drawn which will apply to every possible case. If there be no decimals either in the dividend or divisor, the rule has been already explained. Thus the division of 17 by 6 is the same thing as the reduction of $\frac{17}{6}$ to a decimal fraction, since the sixth part of unity repeated 17 times is the sixth part of 17. Again, we must observe that when two fractions have the same denominator, their quotient is the same as the quotient of their numerators. Thus $\frac{2}{3}$ is contained in $\frac{17}{3}$, just as 2 is contained in 17. By the rule, $\frac{17}{3}$ divided by $\frac{2}{3}$ gives $\frac{51}{6}$, which having the numerator and denominator both divisible by 3, is the same as $\frac{17}{2}$. If then two fractions have the same denominator, the denominator may be rejected in division, and the one numerator divided by the other. Two decimal fractions may be reduced to the same denominator by annexing ciphers to the right of that which has the fewest number of places, so as to make the same number of places in both. For we have shown that a decimal is not altered by annexing ciphers on the right, and we know that two decimals which have the same number of places have the same denominator, viz. unity followed by as many ciphers as there are places. If then, we have to divide 42·1 by ·0017 we begin by annexing three ciphers to 42·1, which gives 42·1000 and ·0017, which having the same denominator, we retain only the numerators, which

are 421000 and 17. It only remains to reduce $\frac{421000}{17}$ to a decimal fraction, to do which we annex as many *more* ciphers to the numerator as we want decimal places. Thus, if we want 4 places, we divide 421000,0000 by 17, the quotient of which, taking no account of the remainder, is the answer required. Again, to divide 4·03812 by 1161·7, we annex four ciphers to the latter, and reject the denominators, which gives 403812 and 116170000. We then reduce $\frac{403812}{116170000}$ to a decimal fraction; but in doing this, the rule may be somewhat simplified, since the annexing a cipher to the numerator is the same thing as taking one away from the denominator: thus $\frac{4038120}{116170000}$ is the same fraction as $\frac{403812}{11617000}$. If therefore we want five places of decimals, instead of annexing five ciphers to the numerator, we take away the four from the denominator and annex one to the numerator, and divide 4038120 by 11617, the quotient of which is 347; and as there are to be 5 decimal places, the result is ·00347. Similarly to divide 42 by ·007, we divide 42000 by 7, which gives 6000.

When any decimals are thrown away from a result, it is more correct to increase the last remaining figure by 1, if the first figure thrown away were 5 or upwards. Thus, if out of ·13885, we retain only four places, we write it ·1389, this being nearer to ·13885 than ·1388. If we retain 3 places only, we write ·139. On the same principle, if we had to mention 278 in round numbers, we should rather call it 300 than 200.

Bias of the Mind respecting the Future.—The common bias of the mind undoubtedly is, (such is the benevolent appointment of Providence,) to think favorably of the future, to overvalue the chances of possible good, and to underrate the risk of possible evil; and in the case of some fortunate individuals, this disposition remains after a thousand disappointments. To what this bias of our nature is owing it is not material for us to inquire; the fact is certain, and it is an important one to our happiness. It supports us under the real distresses of life, and cheers and animates all our labors; and although it is sometimes apt to produce, in a weak and indolent mind, those deceitful suggestions of ambition and vanity, which lead us to sacrifice the comforts and duties of the present moment to romantic hopes and expectations, yet it must be acknowledged, when connected with habits of activity, and regulated by a solid judgment, to have a favorable effect on the character, by inspiring that ardor and enthusiasm which both prompt to great enterprizes, and are necessary to insure their success. When such a temper is united (as it commonly is) with pleasing notions concerning the order of the universe, and in particular concerning the condition and the prospects of man, it places our happiness in a great measure beyond the power of fortune. While it adds a double relish to every enjoyment, it blunts the edge of all our sufferings; and even when human life presents to us no object on which our hopes can rest, it invites the imagination beyond the dark and troubled horizon which terminates all our earthly prospects, to wander unconfined in the regions of futurity. A man of benevolence, whose mind is enlarged by philosophy, will indulge the same agreeable anticipations with respect to society; will view all the different improvements in arts, in commerce, and in the sciences, as co-operating to promote the union, the happiness, and the virtue of mankind; and, amidst the political disorders resulting from the prejudices and follies of his own times, will look forward with transport to the blessings which are reserved for posterity in a more enlightened age.—[Dugald Stewart.]

Co-operative Laborers.—Many of our readers are no doubt aware that some well-intentioned men have been endeavoring for a long time to effect a great change in society, by establishing a new arrangement, called Co-operation, which assumes that the laborers should be at the same time the capitalists. There can be no sort of objection to this principle, when it is proposed to carry it into action without any prejudice to the existing laws of property; and, no doubt, many of the evils of our social state might be removed, were all persons concerned in the business of production to have a sort of proprietary interest in the commodities produced. The mistake of those who exclusively call themselves co-operatives, is that of assuming that the love of individual property can be got rid of by a very short process of reasoning, and neglecting to avail themselves of the many *practical* modes in which industry might be made more productive than at present, by a union of forces, in which the personal interests of every laborer would be dependent upon the success of the business in which he is engaged. There are many examples of such real co-operation already existing in the world, some

of which we may mention, from time to time. We shall now state a few facts regarding the mode of navigating vessels in the Mediterranean, by men having a common proprietorship.

With the exception of some large ships that belong to wealthy merchants of Hydra, Spezzia, &c., chiefly employed in the corn trade in the Black Sea, nearly all the Greek vessels are navigated by men taking fixed shares of the profits or freights obtained. The captain has more shares than the common men, and so has the second in command, who is generally intrusted with the *contabiliti* or accounts. When the vessel is small and the voyage short, it is sometimes the custom for each individual to lay in his own wine and provisions; but the general practice is for the captain or the second to purchase a stock for the whole, the amount of which is put on the debtor side of the account, and at the end of the voyage subtracted from the gains made: the distribution being fairly conducted during the voyage. The same system is found nearly all over the Mediterranean. The Neapolitans, the Sicilians, and the Genoese, rarely navigate in any other way.

The Italian captain has sometimes a share in the vessel, which proportionately increases his share in the profits. He is occasionally, though rarely, except when the craft is very small, the sole proprietor; but even in the latter case the men are engaged just in the same way. A small vessel called a "Bovo," or a "Paranza," of not more than sixty tons, not worth £150, is often held by as many as six or ten different proprietors.

From the town of La Torre dell' Annunziata, in the Bay of Naples, there is a coral fishery carried on. They sometimes fish about Sardinia, but the great place is on the coast of Africa, near Bona. They leave Naples in little fleets of four, six, or eight, open boats, and availing themselves of the fine summer season, venture right across the Mediterranean. These boats are navigated on the same principle. Sometimes the boat is the united property of the men in it, who give one of their number a larger share of the profit on account of his superior nautical skill or experience in the fishery. The abstemious manner in which these Mediterranean sailors, (Italians, Greeks, Sclavonians, Spaniards, Provençales, and all,) live is astonishing. Bread, *legumes*, olives, salt-fish, a little maccaroni, are their sole support. They scarcely ever taste meat.

A large portion of the shore boats that ply about the harbor at Smyrna are manned by Sclavonians, from about the Bocca di Cattaro, and by our subjects the Maltese. On an average each boat has two men; to them the boat belongs, and they divide their profits every evening. When an old boat is to be repaired, or a new one bought, the two partners club together; or sometimes, in the case of the purchase of a new boat, a third party is admitted, who receives a given share of what the boat makes.

In the Italian ships such of the sailors as have a little money are allowed to invest it in goods, and to carry these goods with them, disposing of them as they choose at the ports they touch at or are bound to. This is called the "*Paccotiglia.*" Intelligent and prudent sailors often make more money this way than by their shares in freight.

Those who have attended to this system state that the sailors are deficient in discipline; but they also observe that, in proportion as the men are of a steady and intelligent character, this evil vanishes. It is no doubt true that *mutual* interests can only be properly understood by men far advanced in civilization. Ignorance is always selfish.

On the Eye—Duration of Impressions. [From Dr. Arnott's Elements of Physic.]

Any impressions of light made upon the retina lasts for about the sixth of a second. Hence, when the burning end of a stick is made to describe any line or curve, its path becomes a line of light; and if it revolve in a circle six times in a second, that circle will appear to the eye a complete circle of fire. The polished end of an elastic wire, fixed by its other end in a block of wood, being made to vibrate, similarly forms a line or curve of light. A harp-string, while vibrating as it sounds, appears like a flat riband. Lightning or other meteor, darting across the sky, although, in fact, but a moving luminous point, is generally thought of as a long line of light: the term forked-lightning has reference to this prejudice. The same remark applies, in a degree, to a sky-rocket in its rapid ascent. Two or more colors painted separately on the rim of a wheel which is made to turn rapidly, appear to the eye to be as completely united as if they were really mixed: it has been already explained how patches of the various colors of the rainbow mixed in this way form white light. If on one side of a card a little bird be painted, and on a corresponding part of the other side a cage, then, on making

the card turn rapidly by twisting between the fingers two threads fixed to its opposite edges, the little bird will appear to be imprisoned in the cage: or, again, if a pensive Juliet sitting in her bower occupy one side of the card, and a longing Romeo the other, by the magic turn of the threads the passionate lovers may instantly be brought together. Dr. Paris displayed taste and an amiable ingenuity, in designing this toy with great variety of subjects.

A certain intensity of light is necessary to distinct vision, but the degree varies with the previous state of the organ. A person passing from the bright day into a shaded room, for a time may fancy himself in total darkness; and to persons sitting in the room and become accustomed to the less light so as to see well with it, he will appear to be almost blind. The dawn of morning after the darkness of night appears much brighter than an equal degree of light in the evening. When, as the night falls, our lamps or candles are first introduced, the glare is often for a time offensive: and the same feeling is still stronger on opening, in the morning, bedroom window shutters or close-drawn curtains. After the repose of night, the sensibility of the eye is such that the globules of blood in the capillary vessels of the retina produce the impression on it of little globes of light, crossing among each other as the tortuous vessels do. To a prisoner, after a long confinement in a dark dungeon, the light of the sun is almost insupportable. And a dungeon, which to common eyes is utterly dark, still to its long-held inmate has ceased to be so. There are various instances in the records of the barbarous ages, of prisoners confined for years in utter darkness, who at last could see and make companions of the mice which frequented their cells. The darkness of a total eclipse after bright sunshine appears much more deep than that of midnight, because of the sudden contrast. The long polar night of months ceases to appear very dark to the polar inhabitants. If an eye be directed for a time to a black wafer laid on a sheet of white paper, and afterwards to another part of the sheet, a portion of the paper of the size of the wafer will appear brilliantly illuminated; for the ordinary degree of light from it appears intense to the part of the eye lately receiving almost none. An eye directed long and intensely upon any minute object—as when a sailor watches a speck in the distant horizon, supposed to be a ship, or when a hunter on the brown heath keeps his eye fixed on some game nearly of the color of the heath, or when an astronomer gazes long at a little star—has the sensibility of its centre at last exhausted, and ceases to perceive the object; but on directing the axis of the eye a little to one side of the object, so that an image may be formed only *near* the centre, the object may be again perceived, and the centre in the mean time enjoying repose will recover its power.

But the most extraordinary fact connected with the sensibility of the retina is, that if part of it be strongly exercised by looking for a time at an object of any bright color, on then turning the eye away, or altogether shutting it, an impression or spectrum will remain of the same form as the object lately contemplated, but of a perfectly different color. Thus, if an eye be directed for a time to a red wafer laid on white paper, and be then shut or turned to another part of the paper, a beautifully bright green wafer will be seen; and *vice versa*, a green wafer will produce a red spectrum, an orange wafer will similarly produce a blue spectrum, a yellow one a violet spectrum, &c.; and a cluster of wafers will produce a similar cluster of opposite colors. If the hand be then held over the eyelids to darken the eyes and prevent entirely the approach of light, the spectrum of the bright parts will be luminous, surrounded by a dark ground, and when the hand is again removed the contrary will be true. Again, if the eye be in a degree fatigued by looking at the setting sun, or even at a window with a bright sky beyond it, or at any very bright object, on then shutting it, the lately contemplated forms will be perceived, first of one vivid color, and then of another, until perhaps all the primary colors have passed in review. These extraordinary facts prove that the sensation of light and color, although excitable by light, is also producible without it. This truth gave occasion to Darwin's ingenious theory, that the sensation of any particular color, of red for instance, is dependent upon a certain state of contraction of the minute fibres of the retina, as the sensation of a particular tone depends on a certain frequency of vibration of some part of the ear, and that the fibres, when fatigued in that condition, seek relief, when at liberty, by throwing themselves in an opposite state—as a man, whose back is fatigued by bending forward, relieves himself not by merely standing erect, but by bending the spine backwards—which new condition, whether produced by light or by

any other cause, gives the sensation of green. He applied his explanation similarly to all other cases of color. It is remarkable that the colors which thus appear opposite to each other in kind are those which, when the solar spectrum produced by a prism, as described a few pages back, is painted round a wheel or circle, are opposite to each other in place.

There are persons who, although having distinct perceptions of form and of light and shade, have not the power of distinguishing colors. It is common for such persons to deem pink and pea-green (naturally opposites) the same color, and therefore not to distinguish difference of color in a red berry and the leaves around it. A man with this defect, trusting to his own judgment, might, without knowing it, dress himself like a parrot.

Largest Column in the World.—The following is an account of the monument erected by the Emperor Nicholas to the memory of his brother, the late Emperor Alexander. The shaft was placed on its pedestal on St. Alexander Nefskey's day, August 30, (O. S.) 1832, in the presence of the imperial family, nobility, citizens, and strangers. The day was remarkably fine, and an immense concourse—an almost countless multitude—assembled to witness the operation, in the large square in front of the Hermitage, or winter palace of the Emperor. The monument is of red granite. The pedestal, which is square, is 40 feet high; the shaft is round and in one piece; it is 85 feet high and 12 feet in diameter at the top; it weighs 600 tons. The column supports a colossal bronze statue, representing an angel holding a cross. The statue, with its pedestal, including the capital of the column, is 35 feet high, and the height of the monument from the ground to the top of the statue is 165 feet. The stone was brought from Finland, (from the same quarry where the celebrated pillars of the castle and church, polished like marble, were procured,) and transported to St. Petersburgh in a ship built for the purpose, towed by a steamboat. The inclined plane on which the shaft was rolled from the river Neva to its present site, contained a forest of wood, and cost in that country, where it is so cheap, a million of rubles, or $200,000. The column was raised and safely placed on its pedestal by means of 60 capstans, manned by 2500 veterans, who had served with Alexander in his most glorious campaigns. Each of them wore badges of honor. The preparations for the stupendous undertaking were so complete, that not the slightest accident occurred; and during the operation of raising the shaft, not a whisper nor a word was heard throughout the vast multitude who witnessed the scene.

Effects of Climate and Passions on the Mind.—Climate, by its influence upon the body, produces endless diversities of mind. Compare the timid, indolent, vivacious, and irritable inhabitant of the line, with the phlegmatic and stupid Greenlander. Every man knows how the state of his mind is modified by different periods of the day, changes in the weather, and the seasons.* He who attempts mental effort during a fit of indigestion will cease to wonder that Plato located the soul in the stomach. A few drops of water upon the face, or a feather burnt under the nostril of one in a swoon, awakens the mind from its deep sleep of unconsciousness. A slight impression made upon a nerve often breaks the chain of thought, and the mind tosses in tumult. Let a peculiar vibration quiver upon the nerve of hearing, and a tide of wild emotion rushes over the soul.

> "By turns they feel the glowing mind
> Disturbed, delighted, raised, refined."

Strike up the Marseilles in the streets of Paris, and you lash the populace into fury. Sing the Ranz des Vaches to the Swiss soldiers, and they gush into tears. The man who can think with a gnat in his eye, or reason while the nerve of a tooth is twinging, or when his stomach is nauseated, or when his lungs are oppressed and laboring,—he who can give wing to his imagination when shivering with cold, or fainting with heat, or worn down with toil,—can claim exemption from the common lot of humanity. In different periods of life, the mind waxes and wanes with the body; in youth, cheerful, full of daring, quick to see, and keen to feel; in old age, desponding, timid, perception dim, and emotion languid. When the blood circulates with unusual energy, the coward rises into a hero; when it creeps feebly, the hero sinks into a coward.

The effects produced by different states of the mind upon the body are equally sudden and powerful. Plato used to say, that "all the diseases of the body proceed from

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* It is a well known fact, that almost all the suicides which take place in London and Paris are committed during the *rainy season*.

the soul." The expression of the countenance *is mind visible*. *Bad news* weakens the action of the heart, oppresses the lungs, destroys appetite, stops digestion, and partially suspends all the functions of the system. An emotion of shame flushes the face; fear blanches it; joy illuminates it, and an instant thrill electrifies a million nerves. Surprize spurs the pulse into a gallop. Delirium infuses giant energy. Volition commands, and hundreds of muscles spring to execute. Powerful emotion often kills the body at a stroke. Chilo, Diagoras, and Sophocles, died of joy at the Elean games. The news of a defeat killed Philip V. One of the popes died of an emotion of the ludicrous, on seeing his pet monkey robed in pontificals, and occupying the chair of state. Muley Moluck was carried upon the field of battle in the last stages of an incurable disease. Upon seeing his army give way, he leaped from the litter, rallied his panic stricken troops, rolled back the tide of battle, shouted victory, and died. The door-keeper of Congress expired upon hearing of the surrender of Cornwallis. Eminent public speakers have often died, either in the midst of an impassioned burst of eloquence, or when the deep emotion that produced it had suddenly subsided. The late Mr. Pinckney, of Baltimore, Mr. Emmet, of New-York, and the Hon. Ezekiel Webster, of New-Hampshire, are recent instances. Lagrave, the young Parisian, died, a few months since, when he heard that the musical prize for which he had competed was adjudged to another. The recent case of Hills, in New-York, is fresh in the memory of all. He was apprehended for theft, taken before the police, and though in perfect health, mental agony forced the blood from his nostrils. He was carried out, and died.—[Annals of Education.]

Founders of Colleges.—Who ever heard of a liberally educated man who was not the hearty devoted supporter of every judicious common school system? Such an anomaly our country has not yet produced. Our most illustrious patriots and sages have been the founders of colleges, and apostles in the cause of universal education.

It is no uncommon thing, in our country, for men of considerable influence to boast that they have never seen the inside of a college—that, like Franklin and Washington, they have advanced in knowledge and reputation by their own unassisted efforts; and consequently, that colleges are good for nothing, or at best fitted only for the training of drones and blockheads. Now, besides the extreme modesty of recording their own names upon the same tablets with Franklin and Washington, they might be reminded that those truly great men never uttered such a boast, and never decried such institutions. Franklin was the father of the University of Pennsylvania, and Washington endowed a college in his native state. No man, therefore, will ever give any very convincing evidence that he resembles Franklin or Washington, by a supercilious affectation of contempt for colleges, or by a narrow, invidious, systematic, malignant hostility towards them.—[President Lindsey on Education.]

Economy.—Every enlightened Christian community, since the creation of the world, has had political and pecuniary prosperity. Commodious churches and school-houses always produce commodious dwellings, well cultivated farms, convenient vehicles and good roads.

Five dollars expended upon infant schools always prevents more poverty and crime than five thousand spent on prisons, courts, and other legal provisions to protect the morals of a community.

Two dollars will provide a year's entertainment and instruction at a Lyceum; from three to ten dollars will furnish one evening's entertainment at a ball.

Commodious Lyceum Buildings have generally paid from one to two hundred per cent. interest on the money they cost.

The expenses of horse-racing in the United States for one year is sufficient to erect an elegant Lyceum in every town and village in the Union.

The interest of the money expended for the Pennsylvania State Prison is sufficient to pay the tuition of ten thousand children at infant schools.

The money annually expended for military trainings in Massachusetts is sufficient to establish and endow a Lyceum Seminary, or self-supporting school, in every county in the State, at thirty thousand dollars each.

Doing Good.—Instead of showing our love to our country by engaging eagerly in the strife of parties, let us choose to signalize it rather by beneficence, and by an exemplary discharge of the duties of private life, under the persuasion that a man, in the final issue of things, will be seen to have been the

best patriot who is the best Christian. He who diffuses the most happiness, and mitigates the most distress, within his own circle, is undoubtedly the best friend to his country and the world, since nothing more is necessary than for all men to imitate his conduct, to make the greatest part of the misery of the world cease in a moment. While the passion, then, of some is to *shine*, of some to *govern*, and of others to *accumulate*, let one great passion alone inflame our breasts, the passion which reason ratifies, which conscience approves, which heaven inspires—that of being and doing good.—[Rob. Hall.]

Mechanical Skill of the Ancient Egyptians.—A paper was read, on the 11th June, 1832, at the French Academy of Sciences, by M. Jomard, which shows, from the hieroglyphic remains found on the Egyptian monuments, that most of the principal mechanical instruments with which we are now acquainted were known to them. In a picture found in the Palace of Carnac, are seen a vessel fixed by means of anchors, and a capstan in connection with it; it is also seen from it that the ancients were acquainted with the vice. It appears to be by means of inclined planes and capstans that they raised the immense blocks of stone of which their great monuments are composed. M. Jomard also proved that they knew the use of the pulley.—[Lond. Mec. Mag.]

Black Colors.—The blackness of bodies is supposed by philosophers to be owing to the luminous rays that fall upon them being in great part absorbed or stifled in their pores; and hence they also receive heat more freely than others. Black marble or tiles, exposed to the sun, become sensibly hotter than white ones. Black paper is kindled by a burning glass much sooner than white, and the difference is strongly marked; a burning glass too weak to have any visible effect at all upon white paper, shall readily kindle the same paper rubbed over with ink; hence black clothes, when wetted, are said to dry faster; black habits, and rooms hung with black, to be warmer; black mould to be a hotter soil for vegetables; and garden walls, painted black, to answer better for ripening of wall fruit than those of lighter colors. It is not, however, to be affirmed, that the like differences obtain in the impressions made by common fire. Black paper held to the fire does not seem to be effected sooner, or in a greater degree, than such as is white. It may be proper to observe also, that the combustibility of the paper may be increased, by impregnating it with substances of themselves not combustible, and which give no color to it. This is the foundation of one of the sympathetic inks, as they are called, made of a strong solution of sal ammoniac in water; which, though colorless when written with on paper, becomes very legible on exposing the paper to the fire—that is, it occasions the parts moistened with it to scorch or burn before the rest of the paper is hurt, to a brown or black.

Steel Engravings.—A Mr. Percy Heath has discovered a mode of re-biting steel plates, by which he can bring up to color those tints which are usually considered incapable of profiting by that process. This method promises to be useful in restoring worn plates, or such as merit to be repaired.—[Athenæum.]

Consumption of Silk.—The quantity of this material used in England alone amounts in each year to more than four millions of pounds weight, for the production of which myriads upon myriads of insects are required. Fourteen thousand millions of animated creatures annually live and die to supply this corner of the world with an article of luxury. If astonishment be excited at this fact, let us extend our view into China, and survey the dense population of its widely spread region, whose inhabitants, from the Emperor on his throne to the peasant in the lowly hut, are indebted for their clothing to the labors of the silkworm. The imagination, fatigued with the flight, is lost and bewildered in contemplating the countless numbers which every year spin their slender threads for the service of man.—[Lardner's Cyclopædia.]

How to tin Nails, Tacks, &c.—First clean the surface of the articles to be tinned from rust or other oxide, by pickling them, or putting them into sulphuric, muriatic, or nitric acid, diluted with water, as usual, and washing them well afterwards in water; then put them into a stone-ware gallon bottle, together with a proportionate quantity of bar or grain tin, and of sal ammoniac: next place this vessel, lying upon its side, over a charcoal fire, made upon a forge hearth, and keep turning it round, and frequently shaking it, to distribute the tin uniformly over the surface of the articles to be tinned; lastly, throw the articles into water, to wash away all the remains of the sal ammoniac, and fi-

nally ory them in saw dust made warm. The great merit of this process consists in the employment of the stone-ware vessel, which not only prevents the dissipation of the sal ammoniac in fumes, but also gives up the whole of the tin to the articles to be tinned, which would not be the case were a metallic vessel to be used.

To imitate Leaf-Gilding on Leather.—Take some calf-skins which have been softened in water, and beat on a stone to their greatest extent whilst wet; rub the grain side of the leather with a piece of size, whilst in a state of gelly; and before this size dries, lay on a number of silver leaves. When covered with the silver leaf, the skins are to be dried till they are in a proper state for burnishing, which is performed by a piece of large flint fixed in a wooden handle; the appearance of gold is then given to the silvered surface by covering it with a yellow varnish, or lacker, which is composed of four parts of white resin, the same quantity of common resin, two parts of gum sandarac, and two parts of aloes. These ingredients are to be melted together in an earthen vessel, and after being well mixed by stirring, twenty parts of linseed oil is to be poured in; and when the composition is sufficiently boiled to make a perfect union, and to have the consistence of a syrup, half an ounce of red lead is to be added, and the liquid passed through a flannel bag. To apply this varnish, the skins must be spread out upon a board, fastened down by nails, and exposed to the rays of the sun, and when thus warmed, the white of an egg is to be spread over the silver. After it is dry the varnish is laid on, which will dry in a few hours, and is very durable.

Useful Discovery.—A machine has been invented and put in operation, in Philadelphia, for napping hats by steam. The editor of the Philadelphia Inquirer recently witnessed the performance of this machine in a hat manufactory, and speaks in high terms of its capabilities. The beauty and superiority of the work are at once admitted by all who have examined it. It is not stated whether or not the process is more rapid than by the old method; but it is held to turn out a much better article, as the napping process requires very hot water, and steam applied to the same purpose may be many degrees hotter than boiling water. The invention is thought to be a very useful one.

Manufacture of Glass.—In the whole circle of manufactures there is not any thing more curious than the one that is depicted in the above engraving.* Materials, which appear of themselves but little fitted for any useful purpose, are blended together so as to form compounds of a new and entirely distinct character. Indeed, an uninitiated person looking at the sand, lead, and pearl-ashes, as they are prepared for the glass houses, would consider that nothing less than the wand of the enchanter could accomplish their change into a hard and crystalline body.

The ingredients usually employed in the manufacture of glass, with their relative proportions, may be thus briefly described:

120	parts of	well washed white sand
40	"	purified pearl-ashes
35	"	litharge
13	"	nitre
1	"	black oxide of manganese.

When these materials are collected and properly proportioned, they receive a certain amount of calcination prior to their being placed in the melting pot. This operation is called *fritting*, and is performed either in small furnaces adjoining to the proper glass furnace, and heated by the same fuel, after its principal force has been expended on the glass pots, or else in ovens constructed for the purpose. The use of this preparatory process is to discharge all moisture from the ingredients, and to drive off the carbonic gas. This operation is performed gradually, and carried to the point of semi-vitrification. When the materials are sufficiently "fritted," they are thrown with clean iron shovels, through the side opening of the furnace, into the glass-pots, the fire having been previously raised to its greatest intensity. When filled, the opening is closed with wet clay, excepting a small hole for examining the interior of the furnace. The mass soon begins to heave, and exhibit a mass of liquid grandeur, like the waves of the ocean on fire. During this process, samples for examination are frequently brought out by the aid of an iron rod, and the glass becomes beautifully clear and transparent. The glass may now be considered as completely made, but it requires some time to cool down to the requisite working temperature. It should be just soft enough to yield with ease to any external impression, even to the force of the breath, when impelled against the glowing

* We think this description may be sufficiently understood by our readers without the engraving.

mass, and in that state it may be bent into any required form. Such, indeed, is its tenacity, that it may be rapidly drawn into a solid string, and wound on a reel, many miles in length. Having thus brought the glass to a state fit for what is technically called "blowing," we may introduce our readers into the workshop itself, which will be best done by the aid of a graphic illustration, and the engraved view at the head of this article will admirably answer the purpose. In the present season of the year the temperature of the blowing-house would shame the hottest portions of the torrid zone, and while we now write, we are laboring under the enervating effects of a visit, many hours back, when the thermometer stood at 140 degrees.

The workmen who are represented in the engraving are each engaged in one of the operations essential to the manufacture of a common drinking glass. For this purpose the operator takes a hollow tube, about four feet long, called a blowing iron, and dipping it into the melting-pot, turns it round till a portion of the glass adheres to the surface. He then holds it near the ground, so that the mass is extended by its own weight, and blows strongly into the tube. The breath penetrating the red hot mass enlarges it, and it becomes an elongated sphere of the requisite dimensions. To separate this globe from the iron tube, an assistant dips the end of a solid rod into the glass-pot, and bringing out at its extremity some of the melted glass, thrusts it immediately against the globe at the part directly opposite the neck, so that it may be firmly united. The workman then wets a small piece of iron with his mouth, and lays it on the neck of the globe, and it immediately cracks off, leaving the globe open at the neck. This is again introduced into the fire by the new bar of iron, and afterwards rounded on the rails of a sort of arm-chair. In order to detach the foot from the iron, moisture is again applied, and it drops off. There is a final process called *annealling*, which consists in raising the temperature in a separate oven, and afterwards allowing the glass to cool gradually; it is less likely to break.

Pliny attributes the invention of glass entirely to chance, and relates that it was first made in Syria by some mariners, who were driven on shore on the banks of the river Belus; and who having occasion to make large fires on the sands, burnt the *kali* which abounded on that shore; and that the alkali of the plant uniting with a portion of the sand on which the fire stood, produced the first stream of melted glass that had ever been observed.—[People's Magazine.]

Messrs. Hoe & Co.'s Manufactory.—This extensive establishment, which gives constant employment to upwards of one hundred mechanics, is situated in Gold street. A correct view of the exterior will be found in a steel plate engraving which accompanies this number; of the interior we shall endeavor to give a short description, commencing with the basement of the back shop, denominated in the engraving the machine-shop, in which there is a powerful steam-engine, which by means of shafts convey the power into every work-shop on the premises.

On the first floor are several engines, or slide lathes, which are used for turning, boring, screw-cutting, and a variety of other purposes. In this room are grind-stones and polishing-wheels, for finishing saws and other purposes, and two large lathes used for turning beds and plattens for presses or other flat surfaces.

The second story is occupied by artizans engaged in the construction of single Napier presses, as improved by Mr. Newton, one of the proprietors.

The third story is used as a printers' joiner's shop, in which are several labor-saving machines, one circular sawing machine, which, when in operation, performs 3,000 evolutions per minute, and a boring machine that performs 4,000 evolutions in the same period.

In the building connecting the front and rear shops is a room containing a machine for cutting the teeth of wheels, &c. The plate which forms the register to the machine is so constructed that it can with accuracy be placed so as to cut 40,000 different sizes.

In the cellar and the first story of the front shop are constructed Smith's patent printing presses, which are so much in request by almost all the printers in the Union. Also, a press used for pressing paper; rollers for callenders, embossing machines, &c., of 300 tons pressure; and a machine for bending iron used for cylinders and other purposes.

In the third story are constructed printing machines with double cylinders; and in the rooms above that, are patterns and models of machinery constructed in this country and in Europe.

Independent of the buildings shown in the engraving, Messrs. Hoe & Co. occupy large premises in Eden's Alley, nearly opposite, in the same street. In that department they have a large furnace for hardening saws; here also is their forging shop, and their manufactory for finishing carpenters' squares, bevels, trowels, circular and hand saws, &c. &c. But as our limits will not permit us to enter into a detailed description of the various tools and machines manufactured in this establishment, we shall subjoin their list of articles made on the premises—it is as follows:

Machine presses, double and single cylinder, for newspapers or book-work; Smith printing presses; copperplate and lithographic presses; copying and seal presses; drop, piercing, and transferring presses; hydraulic and fly presses; standing, cotton, and tobacco presses; bookbinders' and saddlers' presses; bookbinders' shears, ploughs and knives, pressboards, rolls, fillets, sewing benches, &c.; ruling machines; chases and imposing stones; type cases and stands; composing sticks, galleys, and slices; patent stereotype blocks; brass rule of every description; buckskin and composition rollers; moulds for casting rollers; printing ink of every quality; types of every description; screws for paper-makers, for cotton, tobacco, coining, and standing presses, &c.; callenders and embossing machines; silver-platers' mills and rollers; dividing engines; large and small lathes; mill gearing and mill work in general. Also, every variety of saws—cast steel mill, pit, and cross-cut saws; hand, pannel, sash and tenon saws; veneering, table, and compass saws; wood-cutters' and felloe, or turning saws; circular saws, in whole plates or in segments; and gin saws. Doctors, or calico printers' webs, of steel or composition; straw, hay, leather dressers' and saddlers' knives; squares, bevels, trowels, &c. &c.

The punctuality, liberality, and well known business manner in which this establishment is conducted, has insured the proprietors a very large share of patronage, and, we must add, it is not misplaced. Such of our ingenious mechanics, and especially those who reside at a distance, who should visit this city, will pass a pleasant hour in going over this establishment; and that pleasure will be considerably enhanced by the truly affable manners of the principals, who will accompany them and point out every thing deserving notice.

Library of Useful Knowledge, published by the "Society for the Diffusion of Useful Knowledge," London, in numbers of pp. 32, by Baldwin & Co. New-York, W. Jackson, Maiden lane.

We hail most cordially the reprint in this city of this useful and interesting series of books, because it places within the reach of all, scientific and good practical and entertaining knowledge. The contents of the whole series are so varied and so excellent, that it is with some difficulty that we have been enabled to decide upon what to extract for our present purpose. From the life of Sir Isaac Newton the following account of his first notions of his system of Philosophy will be perused with interest:

"Voltaire, in his 'Elements of Philosophy,' says that Mrs. Conduit, Newton's niece, attested the fact.

"One day, as he was sitting under an apple tree, (which is still shown,) an apple fell before him; and this incident awakening, perhaps, in his mind, the ideas of uniform and accelerated motion, which he had been employing in his method of fluxions, induced him to reflect on the nature of that remarkable power which urges all bodies to the centre of the earth; which precipitates them towards it with a continually accelerated velocity; and which continues to act without any sensible diminution at the tops of the highest towers, and on the summits of the loftiest mountains. A new idea darted across his mind. 'Why,' he asked himself, 'may not this power extend to the moon, and then what more would be necessary to retain her in her orbit about the earth?' This was but a conjecture; and yet what boldness of thought did it not require to form and deduce it from so trifling an accident! Newton, we may well imagine, applied himself with all his energy to ascertain the truth of the hypothesis. He considered that if the moon were really retained about the earth by terrestrial gravity, the planets, which move round the sun, ought similarly to be retained in their orbits by their gravity towards that body.* Now, if such a force exists, its constancy or variability, as well as its energy at different distances from the centre, ought to

* Newton afterwards showed the truth of his result, by deducing it from a law observed by Kepler, in the movement of all the planets, which consists in the description of areas proportional to the times, by the radius vector drawn from each planet to the sun; but he did not know how to make use of this law till he had discovered the means of calculating the motion in an elliptic orbit; that is, about the end of the year 1679.

manifest itself in the different velocity of the motion in the orbit; and consequently, its law ought to be deducible from a comparison of these motions. Now, in fact, a remarkable relation does exist between them, which Kepler had previously found out by observation, namely, that the squares of the times of revolution of the different planets are proportional to the cubes of their distances from the sun. Setting out with this law, Newton found, by calculation, that the force of solar gravity decreases proportionally to the square of the distance; and it is to be observed that he could not have arrived at this result without having discovered the means of determining from the velocity of a body in its orbit, and the radius of the orbit supposed to be circular, the effort with which it tends to recede from the centre; because it is this effort that determines the intensity of the gravity, (to which, in fact, the effort is equal.) It is precisely on this reasoning, that the beautiful theorems on centrifugal force, published six years afterwards by Huygens, are founded; whence it is plain that Newton himself must necessarily have been acquainted with these very theorems. Having thus determined the law of the gravity of the planets towards the sun, he forthwith endeavored to apply it to the moon; that is to say, to determine the velocity of her movement round the earth, by means of her distance as determined by astronomers, and the intensity of gravity as shown by the fall of bodies at the earth's surface. To make this calculation, it is necessary to know *exactly* the distance from the surface to the centre of the earth, expressed in parts of the same measure that is used in marking the spaces described, in a given time, by falling bodies at the earth's surface; for their velocity is the first term of comparison that determines the intensity of gravity at this distance from the centre, which we apply afterwards at the distance of the moon by diminishing it proportionally to the square of her distance. It then only remains to be seen, if gravity, when thus diminished, has precisely the degree of energy necessary to counteract the centrifugal force of the moon, caused by the observed motion in her orbit. Unhappily, at this time, there existed no correct measure of the earth's dimensions. Such as were to be met with had been made only for nautical purposes, and were extremely imperfect. Newton, having no other resource but to employ them, found that they gave for the force that retains the moon in her orbit, a value greater by one-sixth than that which results from her *observed* circular velocity. This difference, which would, doubtless, to any other person, have appeared very small, seemed, to his cautious mind, a proof sufficiently decisive against the bold conjecture which he had formed. He imagined that some unknown cause, analogous, perhaps, to the vortices of Descartes,* modified, in the case of the moon, the generel law of gravity indicated by the movement of the planets. He did not, however, on this account, wholly abandon his leading notion, but, in conformity with the character of his contemplative mind, he resolved not yet to divulge it, but to wait until study and reflection should reveal to him the unknown cause which modified a law indicated by such strong analogies. This took place in 1665-6. During the latter year, the danger of the plague having ceased, he returned to Cambridge, but he did not disclose his secret to any one, not even to his instructor, Dr. Barrow. It was not till two years afterwards, 1668, that Newton communicated to the latter, who was then engaged in publishing his lectures on Optics, certain theorems relating to the optical properties of curved surfaces, of which Barrow makes very honorable mention in his preface. Newton had now become a colleague of his former tutor, having been admitted master of arts the preceding year. At length, in the same year (1668), an occurrence in the scientific world compelled him to declare himself. Mercator† printed and published, towards the end of this year, a book called *Logarithmotechnia*, in which he had succeeded in obtaining the area of the hyperbola referred to its asymptotes, by expanding its ordinate into an infinite series; this he did *by means of common divison*, as Wallace had done in the case of fractions of the form $\frac{1}{1-x}$: then considering each term of his series separately, as representing a particular ordinate, he applied to it Wallis's method for curves, whose ordinates are expressed by a single term, and the sum of the partial areas so obtained gave him the value of the whole area. This was the *first* example *given to the world* of obtaining the quadrature of a curve by expanding its ordinate into an infinite series. And it was also the main secret in the general method which Newton had invented for

* Vide Whiston's *Memoirs of himself*, page 23, *&c.*

† Born in Holstein: he passed the greater part of his life in England.

all problems of this nature. The novelty of the invention caused it to be received with general applause. Collins, a gentleman well known to science and philosophy at that time, hastened to send Mercator's book to his friend Barrow, who communicated it to Newton. The latter had no sooner glanced over it, than, recognizing his own fundamental idea, he immediately went home, to find the manuscript, in which he had explained his own method, and presented it to Barrow; this was the treatise *Analysis per œquationes numero terminorum infinitas.* Barrow was struck with astonishment at seeing so rich a collection of analytical discoveries of far greater importance than the particular one which then excited such general admiration. Perhaps, too, he must have been still more surprized at their young author having been able to keep them so profoundly secret. He immediately wrote about them to Collins, who, in return, entreated Barrow to procure for him the sight of so precious a manuscript. Collins obtained his request, and happily, before returning the work, took a copy of it, which, being found after his death among his papers, and published in 1711, has determined beyond dispute, by the date which it bore, at what period Newton made the memorable discovery of expansion by series, and of the method of fluxions. It would have been natural to suppose that an interference with his own discoveries would at last have induced Newton to publish his methods; but he preferred still to keep them secret. "I suspected,' says he, 'that Mercator must have known the extraction of roots, as well as the reduction of fractions into series by division, or at least, that others, having learnt to employ division for this purpose, would discover the rest before I myself should be old enough to appear before the public, and, therefore, I began henceforward to look upon such researches with less interest.'"

Newton was doomed to encounter difficulties as great as fall to the lot of most of us mortal beings. The following account of an incident that deprived him of the fruits of his labors of many years, must excite feelings of regret in the mind of every one:

"Newton had a favorite little dog called 'Diamond.' One winter's morning, while attending early service, he inadvertently left this dog shut up in his room; on returning from chapel, he found that the animal, by upsetting a taper on his desk, had set fire to the papers on which he had written down his experiments; and thus he saw before him the labors of so many years reduced to ashes. It is said that, on first perceiving this great loss, he contented himself by exclaiming, 'Oh, Diamond! Diamond! thou little knowest the mischief thou hast done.' But the grief caused by this circumstance—grief which reflection must have augmented, instead of alleviating—injured his health, and, if we may venture to say so, for some time impaired his understanding. This incident in Newton's life, which appears to be confirmed by many collateral circumstances, is mentioned in a manuscript note of Huygens, communicated to M. Biot, of the French Institute, by Mr. Vanswinden, in the following letter:

"'There is among the manuscripts of the celebrated Huygens, a small journal in folio, in which he used to note down different occurrences; it is side Z., No. 8, page 112, in the catalogue of the library at Leyden: the following extract is written by Huygens himself, with whose hand-writing I am well acquainted, having had occasion to peruse several of his manuscripts and autograph letters. *On the 29th May,* 1694, *a Scotchman of the name of Colin informed me that Isaac Newton, the celebrated mathematician, eighteen months previously, had become deranged in his mind, either from too great application to his studies, or from excessive grief at having lost, by fire, his chemical laboratory and some papers. Having made observations before the Chancellor of Cambridge, which indicated the alienation of his intellect, he was taken care of by his friends, and, being confined to his house, remedies were applied, by means of which he has lately so far recovered his health as to begin to again understand his own Principia.* Huygens mentioned this circumstance to Leibnitz, in a letter, dated the 8th of the following June, to which the latter replied on the 23d. 'I am very happy that I received information of the cure of Mr. Newton at the same time that I first heard of his illness, which, without doubt, must have been most alarming. It is to men like Newton and yourself, Sir, that I desire health and a long life.''

"This account by Huygens is corroborated by the following extract from a MS. at Cambridge, written by Mr. Abraham de le Pryne, dated February 3, 1692, in which, after mentioning the circumstance of the papers being set fire to, he says, 'But when Mr. Newton came from chapel, and had seen what was done, every one thought he would have run mad: he was so troubled thereat, that he was not himself for a month after.' From these

details, it would appear that the mind of this great man was affected, either by excess of exertion, or through grief at seeing the result of his efforts destroyed. In truth, there is nothing extraordinary in either of these suppositions; nor ought we to be astonished that the first sentiments arising from the great affliction which befell Newton were expressed without violence, for his mind was, as it were, prostrated under their weight. But the fact of a derangement in his intellect, whatever may have been the cause, will explain how, after the publication of the Principia, in 1687, Newton, though only forty-five years old, *never more* gave to the world a *new* work in any branch of science; and why he contented himself with merely publishing those that he had composed long before this epoch, confining himself to the completion of those parts that required developement."

It is evident that this great man was impressed with a true and proper sense of the omnipotence of the Almighty Creator of all things. Under the influence of such feelings he penned the following remarks, when explaining the method to be pursued in the study of Natural Philosophy:

"In his treatise on *Optics*, which he had evidently composed and inserted with intentions sincerely religious, and as genuine professions of his firm belief in a divine Providence, he says, 'the main business of this science is to argue from phenomena, without feigning hypothesis, and to deduce causes from effects, till we come to the very First Cause—which certainly is not mechanical: and not only to unfold the mechanism of the world, but chiefly to resolve these and such like questions. What is there in places almost empty of matter, and whence is it that the sun and planets gravitate towards one another, without dense matter between them? Whence is it that nature doth nothing in vain, and whence arises all that order and beauty which we see in the world? To what end are comets, and whence is it that planets move all one and the same way, in orbs concentric, while comets move all manner of ways in orbs very eccentric; and what hinders the fixed stars from falling upon one another? How came the bodies of animals to be contrived with so much art,—and for what ends were their several parts? Was the eye contrived without skill in optics, and the ear without knowledge of sounds? How do the motions of the body follow from the will, and whence is the instinct in animals? Is not the sensory of animals that place to which the sensitive substance is present; and into which the sensible species of things are carried through the nerves and brain, that there they may be perceived, by their immediate presence to that substance? And these things being rightly dispatched, does it not appear from phenomena, that there is a Being incorporeal, living, intelligent, omnipresent, who, in infinite space, as it were, in his sensory, sees the things themselves intimately, and thoroughly perceives them, and comprehends them wholly by their immediate presence to himself; and which things, the images only, carried through the organs of sense into our little sensoriums, are there seen and beheld by that which in us perceives and thinks; and though every true step made in this philosophy bring us not immediately to the knowledge of the First Cause, yet it brings us nearer to it, and on that account is to be highly valued?'

"It is thus that Newton speaks of a Supreme Being; and even those who might dispute the arguments which he gives for such an existence, must still recognize, in this passage, the sentiments of a mind deeply imbued with religious feelings, and convinced of their true foundation."

In one of the two numbers devoted to "Animal Physiology," we find the following interesting account of the wonderful preservative power of life with which some of the feathered tribe are endowed:

"If the accounts given by naturalists of the hybernating condition of certain birds be deemed worthy of credit, how much more wonderful must appear the preservative power of life, and how much more extraordinary the modifications of state in the same animal of which it will admit! That the cuckoo hybernates, and that, when accidentally found in its torpid state, it appears like a dead mass of matter—that it may be rolled about, or even struck with a considerable degree of violence, without producing the slightest sign of sensation—that its respiration and every other manifest vital action seem to be wholly suspended,—are well known facts. Equally familiar to us is the annual migration of swallows from our country, and their regular return to it in the month of April; but it is not so generally known that some of these birds, probably the young and the feeble, remain the whole year in Britain, and as the winter approaches, retiring into the hollows of trees, the clefts of rocks, and the bottom of deep caverns, fall into a torpid

state, and continue in a profound lethargy during the cold months. In the severer climates, the fact of their hybernation is still more abundantly attested; but the most extraordinary statement is that, in such countries, they precipitate themselves into the sea, and into deep lakes and rivers, at the bottom of which they remain during winter in a state of profound torpor. If such accounts may be credited, and they are attested by authorities which can scarcely be questioned, how wonderful must be the action of the vital principle in preserving the life of an animal under circumstances so extraordinary, in an element which would certainly be fatal to it in a few minutes in its ordinary state; with its respiration suspended, its circulation stopped, and its blood—in what condition must we conceive this fluid to remain? If it coagulate, which it must do in a few seconds, unless under some counteracting and controlling influence, it can no longer be a living fluid, and how then can the animal possibly revive? But if it do not coagulate, if it remain alive, and therefore fluid, though at perfect rest, and exposed to such a degree of cold for this length of time, how striking an illustration would this most singular fact afford of the uninterrupted and enduring and efficient action of the vital principle, under circumstances which would seem absolutely incompatible with its existence even for a few moments!"

The society have taken care to blend instruction with amusement in the various treatises issued under their patronage. There is much utility to be gathered from many of them; for instance, we will take the two numbers devoted to an account of the Art of Brewing, and the following circumstance so often occurs in families that we think the account of the experiment will be acceptable to many of our readers:

"An eligible mode of discovering whether beer be in a proper state to yield to finings or not is the following:

"'Draw off a little of the beer into a pint, or half-pint phial, and add to it about half a tea-spoon full of the finings. Shake it up, and then let it remain stationary. If the finings will have the desired effect, you will observe in a few minutes the isinglass collecting the feculencies of the beer into large fleecy masses, which will begin regularly to subside to the bottom. If the beer be not in a proper state, (which is ever the case as long as the fermentation continues, or an after *fret* prevails,) the bulk of the finings will soon be at the bottom, leaving the beer neither pure nor foul, except just at the top, where there will be a little transparency, perhaps a quarter of an inch deep, which will grow deeper in time, but not readily extend to the whole.'"

No drink is more wholesome and nutricious than good beer, but unfortunately it is very rarely to be found in a pure state; the brewers are obliged to sell so low to the retail venders as scarcely to leave any profit, and means are resorted to, to supply the place of malt and hops, which cannot but be injurious to the public health. For instance,

"Bruised *Green Copperas*, called also *salt of steel*, (*sulphate of iron*,) which has always been put into porter—formerly by the brewer, and now by the publican—is, ostensibly, for the purpose of giving it a *frothy top*. It is either used alone, or mixed with *alum*, and is technically called *heading*. The quantity used need not exceed as much as would lie on a half-crown piece for a barrel, and to that extent there is no danger to be feared."

Another very common practice, to which there cannot be any serious objection, is thus described:

"*Egg-shells*, and even whole eggs, are sometimes introduced into beer, in which they act the same part as the carbonates of lime. The shells are, in fact, almost wholly the same substance. The following recipe, which was first published in an early number (the 27th) of the Philosophical Transactions, shows that the use of eggs for the prevention of acidity is of no modern date. The writer (Dr. Stubbs) says that *he learned it from an ale-seller in Deal*, and that he tried it successfully in a voyage to Jamaica. 'To every runlet of five gallons, after it is placed in the ship not to be stirred any more, put in two new-laid eggs whole, and let them lie in it; in a fortnight, or little more, the whole egg-shell will be dissolved, and the eggs become like wind-eggs, inclosed only in a thin skin; after this the white is preyed on, but the yolks are not touched or corrupted, by which means the ale was so well preserved, that it was found better at Jamaica than at Deal.' It may be observed, that although this was new to Dr. Stubbs, he was not the original discoverer. It was probably known *in the trade* for centuries."

We cannot too strongly recommend this series of useful tracts to our readers; they will find much amusement blended with instruction, and the treatises will always be valuable as books of reference on almost all scientific subjects.

METEOROLOGICAL RECORD, KEPT IN THE CITY OF NEW-YORK,

From the 1st to the 30th day of June, 1833, inclusive.

Date.	Hours.	Thermometer.	Barometer.	Winds.	Strength of Wind.	Clouds from what direction.	Weather.
June 1	6 a. m.	62	30.10	sw	moderate	wsw	fair
	10	68	30.13	wsw	..	..	..
	2 p. m.	75	30.10	ssw—s	..	..	..
	6	69	30.10	s—sse	light	..	..
	10	66	30.09	s	..	..	cloudy
" 2	6 a. m.	58	30.08	sw	..	..	.. —thund'r & rain
	10	66	30.02	sse	moderate	wsw / sse	.. fair, with swift scuds fr sse
	2 p. m.	76	29.90	..	..	wsw	
	6	70	29.80	..	..	..	.. —thund'r & rain
	10	70	29.78	s	..	..	.. —fair
" 3	6 a. m.	67	29.76	wsw—w	..	wsw / w	fair wind scuds fr w
	10	72	29.79	w	fresh	..	.. .. ..
	2 p. m.	80	29.80	nnw	..	..	.. .. ..
	6	66	29.91	..	..	nnw	.. .. ..
	10	53	29.08	..	moderate	..	.. .. fr nnw
" 4	6 a. m.	50	30.15	n by w	..	w by s	..
	10	61	30.20	nnw—nne	..	w by s / ne	..
	2 p. m.	66	30.20	n—nnw	light	w / n	..
	6	66	30.20	ssw	moderate	w by n	..
	10	60	30.22	wsw	..		..
" 5	6 a. m.	57	30.25	..	..	wnw	..
	10	72	30.28	sw	..	wnw / ssw	.. light scuds fr ssw
	2 p. m.	76	30.21	s	..	..	..
	6	68	30.15	..	..	w by n	..
	10	65	30.16	..	..	..	
" 6	6 a. m.	67	30.09	ssw	light	..	cloudy (little or no rain on the Hudson above the Highlands.)
	10	65	30.06	sse	..		rain
	2 p. m.	67	30 01	..	..	..	..
	6	64	29·99	s by e	..	wnw / s	cloudy
	10	62	29.95	..	..	..	..
" 7	6 a. m.	61	29.85	nne	..	..	..
	10	64	29.88	ene—e	..		rain —fair
	2 p. m.	66	29.81	e	..	..	cloudy
	6	66	29.80	..	..	..	..
	10	64	29.80	..	..	wnw	fair
" 8	6 a. m.	64	29.81	nne	..	..	..
	10	66	29.85	ene	moderate	..	hazy and foggy
	2 p. m.	68	29.80	sse	..	..	..
	6	65	29.78	..	light	..	..
	10	62	29.77	..	..	w by s	..
" 9	6 a. m.	58	29·63	wsw-wnw	moderate	w by s / nw	fair
	10	65	29.62	nw	fr'h-str'g		..
	2 p. m.	66	29.65	nnw	fr'h-mod.		clear
	6	64	29.69	..	light		..
	10	59	29.72	..	..		..
" 10	6 a. m.	53	29.72	w—wsw	..	nw	fair
	10	65	29·74	sw by w	..	wnw / sw	..
	2 p. m	72	29.63	wsw	moderate	wnw	.. —cloudy
	6	68	29.63	wnw	..	..	cloudy
	10	58	29.68	nnw	..		fair
" 11	6 a. m.	56	29.70	nw—nnw	..	nw	..
	10	65	29.74	nw—w	fresh	..	..
	2 p. m.	72	29.75	..	..	..	..
	6	64	29.80	..	moderate		clear
	10	60	29.84	..	light		..
" 12	6 a. m.	55	29.95	wnw	..		fair
	10	66	29.98	..	moderate	wnw	..
	2 p. m.	74	29.97	w—wsw	..	..	..
	6	72	29.95	w	light	..	..
	10	68	30.00	..	..	w by n	.. cloudy at west
" 13	6 a. m.	61	30·03	ene	..	w by n / wsw	..
	10	70	30.05	s—ene	moderate	..	..
	2 p. m.	79	29.95	sse	fresh	..	.. —cloudy

Remarks.

Arithmetical mean of the thermometer for the month of June, 66.58

Maximum eight of the barometer in June, 30.28 in.—Minimum, 29.62 in.—Range 0.66 in.

The observations of surface winds for June are as follow:

From the North-Eastern quarter including N. 15.

From the South-Eastern, including E. 33.

From the South-Western, including S. 45.

And from the North-Western, including W. 47.

The observations of the highest current of clouds have been as follow:

From the North-Eastern quarter, 0

From the South-Eastern, 1.

From the South-Western, 40.

From the North-Western, 68.

CITY OF NEW-YORK—CONTINUED.

Date.	Hours.	Thermometer.	Barometer.	Winds.	Strength of Wind.	Clouds from what direction.	Weather
June 13	6 p. m.	71	29·87	SSE	moderate	{ W by N / WSW / S }	cloudy
	10	69	29·80		..		.. —lightn'g—thun. st.
" 14	6 a. m.	68	29·80	WSW	..	WSW	fair
	10	74	29·80	..	..	W	..
	2 p. m.	80	29·77	..	light	..	cloudy—fair
	6	74	29·78	..	..	..	fair
	10	69	29·84	..	..		..
" 15	6 a. m.	65	29·84	..	faint	WSW	..
	10	72	29·84	SSW	light	WSW—W	..
	2 p. m.	79	29·78	..	..	WSW	..
	6	76	29·74	SSW—WSW	..	..	.. haze at NW
	10	72	29·74	WSW	..	..	hazy
" 16	6 a. m.	63	29·75	NW	moderate	NW	fair scuds fr NW
	10	75	29·77	WNW	..	WNW	..
	2 p. m.	79	29·73	WSW	fresh	..	..
	6	75	29·71	SW	moderate	..	..
	10	70	29·75	..	..	..	..
" 17	6 a. m.	63	29·80	W—WNW	..	W	..
	10	70	29·85	NW	fresh	WNW	..
	2 p. m.	75	29·89	NNW	moderate	NW	..
	6	68	29·91	..	..		
	10	65	29·99				
" 18	6 a. m.	61	30·07	NNE—NE	..	{ NW / NE }	..
	10	66	30·15	ENE	..	{ NW / ENE / SW }	..
	2 p. m.	72	30·18	S—SSE	..	{ WNW / NE }	..
	6	67	30·15	SSE	.	NNW	..
	10	62	30·20	WSW	light		..
" 19	6 a. m.	60	30·20	..	..	{ NW / SW }	..
	10	66	30·21	S—SSE	moderate	÷	..
	2 p. m.	72	30·18	SSE	..	÷	.. —cloudy
	6	67	30·12	ESE	fresh		cloudy —rainy
	10	66	30·15	..	..		rain
" 20	6 a. m.	65	30·09	SSE	moderate		rainy
	10	68	30·09	..	..		cloudy
	2 p. m.	71	30·10	..	..		..
	6	68	30·09	..	..		..
	10	67	30·09	..	..		..
" 21	6 a. m.	65	30·07	..	..		.. —rainy
	10	67	30·07	S by E	..		rain
	2 p. m.	68	30·07	..	..		..
	6	68	30·01	N	..	{ S / ENE }	.. swift scuds fr NE
	10	65	29·98	..	..		cloudy
" 22	6 a. m.	65	29·99	NNW	..	NW	fair —cloudy
	10	70	29·98	..	..	..	..
	2 p. m.	78	29·97	..	..	..	.. shower at 3½ o'c.
	6	74	29·95	..	..	..	..
	10	70	29·97	..	light	..	..
" 23	6 a. m.	68	29·98	NW	..	WNW	..
	10	76	29·97	..	..	..	..
	2 p. m.	81	29·96	W	..	..	..
	6	76	29·94	..	..	..	..
	10	70	29·93	..	..	..	cloudy
" 24	6 a. m.	66	29·88	E	..	SE	.
	10	65	29·90	ESE	moderate	..	..
	2 p. m.	68	29·80	..	..	..	rainy
	6	67	29·72	..	fresh	..	rain —heavy rain
	10	64	29·70	..	..	..	..
" 25	6 a. m	63	29·60	NW	moderate	{ SW / NW }	cloudy —fair
	10	66	29·62	WNW—W	fresh	W by S	fair
	2 p. m.	70	29·62	WNW	..	..	..
	6	64	29·71	..	..	..	..
	10	60	29·75	..			cloudy
" 26	6 a. m.	59	29·80	NW—E	light	SW by N	rainy —rain
	10	62	29·82	E—WNW	faint	{ SW by W / WNW }	fair —cloudy
	2 p. m.	62	29·80	N	..	÷	cloudy —fair
	6	61	29·82	..	.	÷	fair

Remarks.

The prevalence of North-Westerly winds, both at the surface and in the upper current, have been greater than has been observed in any month during the present year. An unusual quantity of rain for the month of June has also fallen.

On the 2d day of June, tornadoes, hail-storms, and thunder-storms, appeared at various places in different parts of the United States. In the states of Maryland and Pennsylvania the most violent of these appeared in the afternoon; in the state of New-York and in New-England, in the evening. On the night previous a heavy tornado occurred in Illinois. Since that period, storms of this character have occurred in a few instances, particularly on the 17th, when a most severe tornado passed over Delaware county.

The heavy rain which fell in this city on the evening of the 24th June was some hours later in its occurrence in the eastern parts of Long Island Sound, as appears by the reports of the Providence steamboats. During this rain there wind was from ESE, being a di-

CITY OF NEW YORK—CONTINUED.

Date.	Hours.	Thermometer.	Barometer	Winds.	Strength of Wind.	Clouds from what direction.	Weather.	Remarks
June 26	10 p.m.	60	30·03		faint		cloudy —fair	
" 27	6 a. m.	61	30·05	w by s	moderate	wsw	fair	
	10	66	30·09	wnw	..	..	..	rection nearly opposite to the pro-
	2 p. m	70	30·11	..	..	..	..	gress of the rain. Heavy rain al-
	6	66	30·15	nw	..	..	..	
	10	63	30·10				..	so fell at Cincinnati on the 23d
" 28	6 a. m.	58	30·09	ne	faint	..	..	
	10	66	30·09	wsw	..	..	..	and on the morning of the 24th,
	2 p. m.	75	30·14	ssw	light	..	cloudy	which may have been connected
	6	70	30·15	s	faint	..	.. —fair	
	10	66	30·14				fair	with that which fell here on the
" 29	6 a. m.	61	30·11	n	light	wnw	..	night of the 24th.
	10	68	30·13	ne	..	..	..	
	2 p. m.	73	30·14	wsw	..	..	..	
	6	72	30·19	sw	..	..	..	
	10	68	30·12	..	..	..	..	
" 30	6 a. m.	67	30·09	..	..	..	..	
	10	72	30·08	..	..	..	..	
	2 p. m.	80	30·07	s	moderate	..	.	
	6	75	30·05	..	..		clear	
	10	70	30·01	sw	..		..	

METEOROLOGICAL RECORD, KEPT AT AVOYLLE FERRY, RED RIVER, LOU.

For the months of February, March, April, and May, 1833—(*Latitude* 31.10 *N., Longitude* 91.59 *W. nearly.*)

Date. 1833.	Thermometer. Morn'g.	Noon.	Night.	Wind.	Weather, Remarks, &c.
Feb'y 1	41	60	56	calm	clear—river rising half an inch a day
" 2	52	56	54	..	.. —cloudy evening
" 3	46	58	59	ne	.. —calm evening
" 4	42	64	62	calm	.. —peas up
" 5	43	58	61	..	..
" 6	52	61	56	..	cloudy all day
" 7	41	60	60	..	.. morning—clear day
" 8	37	66	64	..	clear—white frost
" 9	41	67	66	..	.. —lettuce, full large heads
" 10	47	68	66	..	.. morning—cloudy evening
" 11	57	73	71	..	cloudy morning—clear evening
" 12	62	70	70	s—high	.. —at night heavy rain
" 13	50	60	60	nw	clear
" 14	45	43	42	ne, morn'g	cloudy—rain all day—calm evening
" 15	40	43	45	calm	.. — .. .. —heavy showers
" 16	52	60	61	..	.. —river rising one inch a day
" 17	48	58	60	..	.. —showers
" 18		56		..	..
" 19		64		..	clear
" 20	50	58	56	nw—high	..
" 21	48	59	61	calm	..
" 22	52	60	59	..	cloudy
" 23	56	62	61	..	.. —rain and thunder
" 24	51	53	48	nw—high	clear—cloudy evening
25	38	52	52	calm	cloudy
" 26	47	60	56	e—light	.. —evening calm and rain
" 27	56	63	62	calm	.. —light showers all day [river risen this month 2 ft. 8 in.
" 28	66	75	70	s—high	.. —gale in the evening and night—at midnight wind n—a severe gale—
March 1	39	36	32	n—severe	.. —rain and spits of snow (the first this winter
" 2	28	42	38	..	clear—calm evening—ice—martin birds appeared
" 3	30	50	49	calm	.. all day
" 4	39	62	60	se—light	cloudy—calm evening
" 5	52	60	62	calm	.. —rain all day
" 6	58	59	56	n	.. —rain in the morning—evening clear and calm
" 7	46	58	52	calm	.. —rain all day
" 8	48	59	58	n—severe	clear all day
" 9	40	66	63	calm	.. ..
" 10	47	70	66	s—light	.. ..
" 11	56	70	67	s—severe	cloudy all day
" 12	62	71	64	s	.. .. —calm and rain all night
" 13	60	58	56	calm	.. —rain in the morning
" 14	56	62	61	..	.. —rain all day
" 15	59	58	53	..	.. — .. .. and night remarkably heavy
" 16	58	62	62	..	foggy morning—rain and thunder severe all day and night
" 17	63	64	64	..	cloudy—rain and thunder all day and night, severe and he.
" 18	65	66	64	s—severe	gales — .. .. ..
" 19	68	73	72	calm	.. —rain—light showers in the evening—wind s and light

AVOYLLE FERRY, RED RIVER, LOU.—CONTINUED.

Date.		Thermometer.			Wind.	Weather, Remarks, &c.
1833.		Morn'g.	Noon.	Night.		
Mar.	20	60	70	74	W	cloudy—evening clear and calm
"	21	51	68	59	calm	clear all day and night—planted corn, beans, &c.
"	22	47	73	64	..	.. .. ..
"	23	56	68	62	..	.. — rain in the evening—wind NW and high all night
"	24	54	72	66	NW	.. — calm evening
"	25	54	71	65	calm	cloudy morning—clear day
"	26	54	74	64	..	clear—rain at night
"	27	60	71	65	..	cloudy—rain and thunder at night from NW, high
"	28	56	52	49	NW	.. —wind high all day and night
"	29	41	59	56	N—light	clear — .. .. .. —gathered turnip and mustard seed
"	30	40	61	58	E—light	.. —light white frost
"	31	42	66	67	NE—light	.. all day and night—Red River at a stand
April	1	58	63	64	SE—strong	cloudy—rain & thunder afternoon & night—gathered mustard & turnip seed
"	2	62	76	70	calm	foggy morning—clear day
"	3	55	80	71	..	clear—planted sweet potatoes, two acres
"	4	60	72	64	NE—light	.. all day—Red River rising
	5	58	74	62	..	.. .. [severe till 12, midnight
"	6	60	66	62	SE—light	cloudy—li ht thunder showers all day—calm at night—rain and thunder
"	7	60	73	66	W	clear
"	8	54	76	63	calm	..
"	9	56	78	67	..	..
"	10	60	74	70	..	cloudy evening—wind S
"	11	68	75	69	S	.. all day
"	12	61	80	66	..	clear—cloudy night
"	13	58	72	62	NE	.. —evening, wind N, and heavy thunder and rain, and at night
"	14	56	58	60	NE—strong	cloudy—calm late in evening and night
"	15	57	66	61	NE—light	.. morning—evening light showers and calm
"	16	58	70	64	W—light	cloudy—evening light showers and calm—peas ripe
"	17	57	72	61	NW—light	clear
"	18	52	76	67	N—light	.. —calm and cloudy night
"	19	58	74	68	E—light	cloudy—calm—clear evening and night
"	20	66	78	71	calm	.. morning—.. .. ..
"	21	65	82	77	..	clear
"	22	70	84	74	..	..
"	23	64	85	72	..	.. —at 5 p. m. shower and very heavy thunder
"	24	64	82	78	..	..
"	25	65	82	74	..	..
"	26	65	83	76	SE—light	cloudy morning—clear—calm day
"	27	66	81	73	SE—high	clear [then calm and cloudy
"	28	72	65	63	SE—severe	cloudy—at 12, noon, a severe gale and rain from W, continued until 4 p. m.—
"	29	65	80	74	calm	.. —even'g & night, heavy thunder showers—new potatoes fit for use
"	30	70	80	76	SE—light	clear—evening, wind high—sweet potatoes come up
May	1	66	79	70	SE—strong	cloudy—light showers
"	2	68	74	73	calm	.. —heavy showers—night calm and clear
"	3	66	72	66	..	.. —light thunder showers—evening wind N and light
"	4	65	80	72	..	clear morning—evening heavy thunder showers—wind S and strong
"	5	63	80	71	..	.. .. SE, light
"	6	66	82	72	..	.. .. —night thunder and light showers
"	7	68	77	71	..	cloudy—evening light showers—wind SE
"	8	69	79	70	NE—light	.. —heavy rain at night and calm
"	9	66	78	70	..	.. —rain, and in evening light showers
"	10	68	82	72	calm	.. morning—evening heavy thunder showers
"	11	66	84	71	..	clear—evening light showers and heavy thunder
"	12	67	78	72	..	.. — .. heavy showers from N—thunder severe and at night
"	13	68	73	73	..	cloudy— .. . . —rain severe—Red River falling
"	14	67	80	77	..	clear all day
"	15	66	85	78	.	. ..
"	16	71	81	76	..	.. ..
"	17	69	83	78	..	.. —evening wind S
"	18	72	82	72	S—light	cloudy evening—thunder shower from NW, severe
"	19	70	84	80	calm	clear
"	20	70	83	79	SW	.. —at night a gale from W—thunder and rain severe
"	21	68	82	72	W, morning	cloudy—calm evening
"	22	71	75	70	SE	.. —rain and thunder heavy all day and night
"	23	68	80	73	W, morning	clear—calm evening
"	24	69	81	73	calm	.. —light flying clouds all day
"	25	68	76	80	..	..
"	26	70	77	80	..	..
"	27	72	87	80	..	..
"	28	75	86	80	SW—light	..
"	29	72	79	73	N, morning	cloudy—rain and thunder severe in evening
"	30	72	84	79	calm	.. morning—clear day
"	31	72	82	80	S	. .. —evening clear

Note.—Red River rose in February 2 feet 8 inches—in March 2 ft. 10 in.—and in April 4 inches, which was within 3¼ inches of extreme high water of 1828; in May, it had fallen 4¼ inches, being 8 inches below high water mark.

APPENDIX.

[In accordance with our notice on the second page of the wrapper, we now commence the re-print of Mr. Babbage's book. Again we beg to remind our readers, that the pages and sheets are so arranged that the book can be bound either as part of the volume of the Magazine, or without it: to bind it with the Magazine we should consider the most judicious, as the index to each volume will be copious, and refer generally to Mr. Babbage's book.]

ON THE ECONOMY OF MANUFACTURES.

INTRODUCTION.

The object of the present volume is to point out the effects and the advantages which arise from the use of tools and machines; to endeavor to classify their modes of action; and to trace both the causes and the consequences of applying machinery to supersede the skill and power of the human arm.

A view of the mechanical part of the subject will, in the first instance, occupy our attention, and to this the first section of the work will be devoted. The first chapter of the section will contain some remarks on the general sources from whence the advantages of machinery are derived, and the succeeding nine chapters will contain a detailed examination of principles of a less general character. The eleventh chapter contains numerous subdivisions, and is important from the extensive classification it affords of the arts in which copying is so largely employed. The twelfth chapter, which completes the first section, contains a few suggestions for the assistance of those who propose visiting manufactories.

The second section, after an introductory chapter on the difference between *making* and *manufacturing*, will contain, in the succeeding chapters, a discussion of many of the questions which relate to the political economy of the subject. It was found that the domestic arrangement, or interior economy of factories, was so interwoven with the more general questions, that it was deemed unadvisable to separate the two subjects. The concluding chapter of this section, and of the work itself, relates to the future prospects of manufactures, as arising from the application of science.

SOURCES OF THE ADVANTAGES ARISING FROM MACHINERY AND MANUFACTURES.

1. There exists, perhaps, no single circumstance which distinguishes our country (England) more remarkably from all others, than the vast extent and perfection to which we have carried the contrivance of tools and machines for forming those conveniences, of which so large a quantity is consumed by almost every class of the community. The amount of patient thought, of repeated experiment, of happy exertion of genius, by which our manufactures have been created and carried to their present excellence, is scarcely to be imagined. If we look around the rooms we inhabit, or through those storehouses of every convenience, of every luxury that man can desire, which deck the crowded streets of our larger cities, we shall find in the history of each article, of every fabric, a series of failures which have gradually led the way to excellence; and we shall notice, in the art of making even the most insignificant of them, processes calculated to excite our admiration by their simplicity, or to rivet our attention by their unlooked-for results.

2. The accumulation of skill and science which has been directed to diminish the difficulty of producing manufactured goods, has not been beneficial to that country alone in which it is concentrated; distant kingdoms have participated in its advantages. The luxurious natives of the East,* and the ruder inhabitants of the African desert, are alike indebted to our looms. The produce of our factories has preceded even our most enterprising travellers.† The cotton of India is conveyed by British ships round half our planet, to be woven by British skill in the factories of Lancashire: it is again set in motion by British capital; and, transported to the very plains whereon it grew, is re-purchased by the lords of the soil which gave it birth, at a cheaper price than that at which their coarser machinery enables them to manufacture it themselves.‡

3. The large proportion of the population of this country, who are engaged in manufactures, appears from the following table, deduced from a statement in an Essay on the Distribution of Wealth, by the Rev. R. Jones:

* The Bandana handkerchiefs manufactured at Glasgow have long superseded the genui[illegible]nes, and are now consumed in large quantities both [illegible] the [illegible]ives and Chinese.—[Crawfurd's Indian Archipelago[illegible] 505.]

† Captain Clap[illegible] when on a visit at the court of the Sultan Bello, states th[illegible] provisions were regularly sent me from the Sultan's table o[illegible]ter dishes with the London stamp; and I even had a piece [illegible]at served up on a white wash-hand basin of English manuf[illegible]e."—[Clapperton's Journey, p. 88.]

‡ At Calicut, in [illegible] Indies, (whence the cotton cloth called calico derives [illegible],) the price of labor is one seventh of that in England, [illegible] market is supplied from British looms.

For every hundred persons employed in Agriculture, there are,

	Agriculturists.	Non-Agriculturists.
In Italy	100	31
In France	100	50
In England	100	200

The fact that the proportion of non-agricultural to agricultural persons is continually increasing, appears both from the Report of the Committee of the House of Commons upon Manufacturers' Employment, July, 1830, and also from the still later evidence of the last census, from which document the annexed table of the increase of population in our great manufacturing towns has been deduced.

Increase of population per cent.:

Names of Places.	1801 to 1811.	1811 to 1821.	1821 to 1831.	Total. 1801 to 1831.
Manchester,	22	40	47	151
Glasgow,	30	46	38	161
Liverpool,*	26	31	44	138
Nottingham,	19	18	25	75
Birmingham,	16	24	33	90

Thus, in three periods of ten years each, during each of which the general population of the country has increased about 15 per cent., or nearly 51 per cent. upon the whole period of thirty years, the population of these towns has, on the average, increased 123 per cent. After this statement, the vast importance to the well-being of this country, of making the interests of its manufactures well understood and attended to, needs no farther argument.

4. The advantages which are derived from machinery and manufactures seem to arise principally from three sources, viz.: The addition which they make to human power; The economy they produce of human time; The conversion of substances apparently common and worthless into valuable products.

5. *Of additions to human power.* With respect to the first of these causes, the forces derived from wind, from water, and from steam, present themselves to the mind of every one; these are, in fact, additions to human power, and will be considered in a future page: there are, however, other sources of its increase, by which the animal force of the individual is itself made to act with far greater than its unassisted power; and to these we shall at present confine our observations. The construction of palaces, of temples, and of tombs, seems to have occupied the earliest attention of nations just entering on the career of civilization; and the enormous blocks of stone moved from their native repositories to minister to the grandeur or piety of the builders, have remained to excite the astonishment of their posterity long after the purposes of many of these records, as well as the names of their founders, have been forgotten. The different degrees of force necessary to move these ponderous masses will have varied according to the mechanical knowledge of the people employed in their transport; and that the extent of power required for this purpose is widely different under different circumstances will appear from the following experiment, which is related by M. Redelet, *Sur l'Art de Batir.*

A block of squared stone was taken for the subject of experiment:

1. Weight of stone - - - 1080 lbs.
2. In order to drag this stone along the floor of the quarry, roughly chiselled, it required a force equal to - - - - - 758
3. The same stone dragged over a floor of planks, required - - 652
4. The same stone placed on a platform of wood, and dragged over a floor of planks, required - 606
5. After soaping the two surfaces of wood which slid over each other, it required - - - 182
6. The same stone was now placed upon rollers of three inches diameter, when it required to put it in motion along the floor of the quarry - - - - 34
7. To drag it by these rollers over a wooden floor - - - 28
8. When the stone was mounted on a wooden platform, and the same rollers placed between that and a plank floor, it required - - 22

From this experiment, it results that the force necessary to move a stone along the roughly chiselled floor of its quarry is nearly two-thirds of its weight; to move it along a wooden floor, three-fifths: by wood upon wood, five-ninths; if the wooden surfaces are soaped, one-sixth; if rollers are used on the floor of the quarry, it requires one-thirty-second part of the weight; if they roll over wood, one-fortieth; and if they roll between wood, one-fiftieth of its weight. At each increase of knowledge, as well as on the contrivance of every new tool, human labor becomes abridged. The man who contrived rollers invented a tool by which his power was quintupled. The workman who first suggested the employment of soap, or grease, was immediately enabled to move, without exerting a greater effort, more than three times the weight he could before.*

6. *The economy of human time* is the next advantage of machinery in manufactures. So extensive and important is this effect, that we might, if we were inclined to generalize, embrace almost all the advantages under this single head; but the elucidation of principles of less extent will contribute more readily to a knowledge of the subject; and, as numerous

* Liverpool, though not itself a manufacturing town, has been placed in this list, from its great connection with Manchester, of which it is the port.

* So sensible are the effects of grease in diminishing friction, that the drivers of sledges in Amsterdam, on which heavy goods are transported, carry in their hand a rope soaked in tallow, which they throw down from time to time before the sledge, in order that it may, by passing over the rope, become greased.

examples will be presented to the reader in the ensuing pages, we shall restrict our illustrations upon this point.

As an example of the economy of time, the use of gunpowder in blasting rocks may be noticed. Several pounds of that substance may be purchased for a sum acquired by a few days' labor; yet when this is employed for the purpose alluded to, effects are frequently produced which could not, even with the best tools, be accomplished by other means in less than many months.

7. The art of using the diamond for cutting glass has undergone, within a few years, a very important improvement. A glazier's apprentice, when using a diamond set in a conical ferrule, as was always the practice about twenty years since, found great difficulty in acquiring the art of using it with certainty, and at the end of a seven years' apprenticeship many were found but indifferently skilled in its employment. This arose from the difficulty of finding the precise angle at which the diamond cuts, and of guiding it along the glass at the proper inclination when that angle is found. Almost the whole of the time consumed, and of the glass destroyed, in acquiring the art of cutting glass, may now be saved by the use of an improved tool. The gem is set in a small piece of squared brass, with its edge nearly parallel to one side of the square. A person skilled in its use now files away one side of the brass, until, by trial, he finds that the diamond will make a clean cut, when guided by keeping this edge pressed against a ruler. The diamond and its mounting are now attached to a stick similar to a pencil, by means of a swivel allowing a small angular motion. Thus the merest tyro at once applies the cutting edge at the proper angle, by pressing the side of the brass against a ruler; and even though the part he holds in his hand should deviate a little from the required angle, it communicates no irregularity to the position of the diamond, which rarely fails to do its office when thus employed.

The relative hardness of the diamond, in different directions, is a singular fact. An experienced workman, on whose judgment I can rely, informed me that he had seen a diamond ground with diamond powder on a cast iron mill for three hours without its being at all worn, but that, changing its direction with reference to the grinding surface, the same edge was ground down.

8. *Employment of materials of little value.* The skins used by the goldbeater are produced from the offal of animals. The hoofs of horses and cattle and other horny refuse, are employed in the production of the prussiate of potash, that beautiful yellow crystalized salt which is exhibited in the shops of some of our chemists. The worn out saucepans and tin ware of our kitchens, when beyond the reach of the tinker's art, are not utterly worthless. We sometimes meet carts loaded with old tin kettles and worn out iron coal-scuttles, traversing our streets. These have not yet completed their useful course; the less corroded parts are cut into strips, punched with small holes, and varnished with a coarse black varnish for the use of the trunk-maker, who protects the edges and angles of his boxes with them; the remainder are conveyed to the manufacturing chemists in the outskirts of the town, who employ them, in conjunction with pyroligneous acid, in making a black die for the use of calico printers.

9. *Of tools.* The difference between a *tool* and a *machine* is not capable of very precise distinction; nor is it necessary, in a popular explanation of those terms, to limit very strictly their acceptation. A *tool* is usually more *simple* than a machine; it is generally used with the hand, whilst a machine is frequently moved by animal or steam power. The simpler *machines* are often merely one or more *tools* placed in a frame, and acted on by any moving power. In pointing out the advantages of *tools*, we shall commence with some of the simplest.

10. To arrange twenty thousand needles thrown promiscuously into a box, mixed and entangled with each other in every possible direction, in such a form that they shall be all parallel to each other, would, at first sight, appear a most tedious occupation; in fact, if each needle were to be separated individually, many hours must be consumed in the process. Yet this is an operation which must be performed many times in the manufacture of needles; and it is accomplished in a few minutes by a very simple *tool;* nothing more being requisite than a small flat tray of sheet iron, slightly concave at the bottom. The needles are placed in it and shaken in a peculiar manner, by throwing them up a very little, and giving at the same time a slight longitudinal motion to the tray. The shape of the needles assists their arrangement; for if two needles cross each other, (unless, which is exceedingly improbable, they happen to be precisely balanced,) they will, when they fall on the bottom of the tray, tend to place themselves side by side, and the hollow form of the tray assists this disposition. As they have no projection in any part to impede this tendency, or to entangle each other, they are, by continually shaking, arranged lengthwise, in three or four minutes. The direction of the shake is now changed, the needles are but little thrown up, but the tray is shaken endways; the result of which is, that in a minute or two the needles which were previously arranged endways become heaped up in a wall, with their ends against the extremity of the tray. They are now removed by hundreds at a time, by raising them with a broad iron spatula, on which they are retained by the forefinger of the left hand. During the progress of the needles towards their finished state, this parallel arrangement must be repeated many times; and unless a cheap and expeditious method had been devised, the expense of manufac-

turing needles would have been considerably enhanced.

11. Another process in the art of making needles furnishes an example of one of the simplest contrivances which can come under the denomination of a *tool*. After the needles have been arranged in the manner just described, it is necessary to separate them into two parcels, in order that their points may be all in one direction. This is usually done by women and children. The needles are placed sideways in a heap, on a table, in front of each operator, just as they are arranged by the process above described. From five to ten are rolled towards this person by the fore-finger of the left hand; this separates them a very small space from each other, and each in its turn is pushed lengthwise to the right or to the left, according as its eye is on the right or the left hand. This is the usual process, and in it every needle passes individually under the finger of the operator. A small alteration expedites the process considerably: the child puts on the fore-finger of its right hand a small cloth cap or finger-stall, and rolling out of the heap from six to twelve needles, he keeps them down by the fore-finger of the left hand, whilst he presses the fore-finger of the right hand gently against their ends; those which have the points towards the right hand stick into the finger-stall; and the child, removing the finger of the left hand, slightly raises the needles sticking into the cloth, and then pushes them towards the left side. Those needles which had their eyes on the right hand do not stick into the finger cover, and are pushed to the heap on the right side previously to the repetition of this process. By means of this simple contrivance each movement of the finger, from one side to the other, carries five or six needles to their proper heap; whereas, in the former method, frequently only one was moved, and rarely more than two or three were transported at one movement to their place.

12. Various operations occur in the arts in which the assistance of an additional hand would be a great convenience to the workman, and in these cases tools or machines of the simplest structure come to our aid; vices of different forms in which the material to be wrought is firmly grasped by screws, are of this kind, and are used in almost every workshop; but a more striking example may be found in the trade of the nail-maker.

Some kinds of nails, such as those used for defending the soles of coarse shoes, called hob-nails, require a particular form of the head, which is made by the stroke of a die. The workman holds the red-hot rod of iron out of which he forms them in his left hand; with his right hand he hammers the end of it into a point, and cutting the proper length almost off, bends it nearly at right angles. He puts this into a hole in a small stake-iron, immediately under a hammer connected with a treadle, which has a die sunk in its surface corresponding to the intended form of the head; and having given one part of the form to the head by the small hammer in his hand, he moves the treadle with his foot, which disengages the other hammer, and completes the figure of the head; the returning stroke produced by the movement of the treadle striking the finished nail out of the hole in which it was retained. Without this substitution of his foot for another hand, the workman would, probably, be obliged to heat the nails twice over.

13. Another, although fortunately a less general substitution of tools for human hands, is used to assist the labor of those who are deprived by nature, or by accident, of some of their limbs. Those who have had an opportunity of examining the beautiful contrivances for the manufacture of shoes by machinery, which we owe to the fertile invention of Mr. Brunel, must have noticed many instances in which the workmen were enabled to execute their task with precision, although laboring under the disadvantages of the loss of an arm or a leg. A similar instance occurs at Liverpool, in the Institution for the Blind, where a machine is used by those afflicted with blindness, for weaving sash-lines; it is said to have been the invention of a person suffering under that calamity. Other instances might be mentioned of contrivances for the use, the amusement, or the instruction of the wealthier classes, who labor under the same natural disadvantages. These triumphs of skill and ingenuity deserve a double portion of our admiration when applied to mitigate the severity of natural or accidental misfortune—when they supply the rich with occupation and knowledge—when they relieve the poor from the additional evils of poverty and want.

15. *Division of the objects of machinery.* There exists a natural, although, in point of number, a very unequal division amongst machines: they may be classed as, 1st, Those which are employed to produce power; and as, 2dly, Those which are intended merely to transmit force and execute work. The first of these divisions is of great importance, and is very limited in the variety of its species, although some of those species consist of numerous individuals.

Of that class of mechanical agents by which motion is transmitted—the lever, the pulley, the wedge, and many others—it has been demonstrated that no power is gained by their use, however combined. Whatever force is applied at one point can only be exerted at some other, diminished by friction and other incidental causes; and it has been farther proved, that whatever is gained in the rapidity of execution is compensated by the necessity of exerting additional force. These two principles, long since placed beyond the reach of doubt, cannot be too constantly borne in mind. But in limiting our attempts to things which are possible, we are still, as we hope to show, possessed of a field of inexhaustible research, and of advantages derived from mechanical skill, which have but

just begun their influence on our arts, and may be pursued without limit—contributing to the improvement, the wealth, and the happiness of our race.

15. Of those machines by which we produce power, it may be observed, that although they are to us immense acquisitions, yet in regard to two of the sources of this power—the force of wind and of water—we merely make use of bodies in a state of motion by nature; we change the directions of their movement, in order to render them subservient to our purposes, but we neither add to nor diminish the quantity of motion in existence. When we expose the sails of a wind-mill obliquely to the gale, we check the velocity of a small portion of the atmosphere, and convert its own rectilinear motion into one of rotation in the sails; we thus change the direction of force, but we create no power. The same may be observed with regard to the sails of a vessel: the quantity of motion given by them is precisely the same as that which is destroyed in the atmosphere. If we avail ourselves of a descending stream to turn a water-wheel, we are appropriating a power which nature may appear, at first sight, to be uselessly and irrecoverably wasting, but which, upon due examination, we shall find she is ever repairing by other processes. The fluid which is falling from a higher to a lower level, carries with it the velocity due to its revolution with the earth at a greater distance from its centre. It will, therefore, accelerate, although to an almost infinitesimal extent, the earth's daily rotation. The sum of all these increments of velocity, arising from the descent of all the falling waters on the earth's surface, would in time become perceptible, did not nature, by the process of evaporation, convey the waters back to their sources; and thus, again, by removing matter to a greater distance from the centre, destroy the velocity generated by its previous approach.

16. The force of vapor is another fertile source of moving power; but even in this case it cannot be maintained that power is created. Water is converted into elastic vapor by the combustion of fuel. The chemical changes which thus take place are constantly increasing the atmosphere by large quantities of carbonic acid and other gasses noxious to animal life. The means by which nature decomposes or reconverts these elements into a solid form, are not sufficiently known: but if the end could be accomplished by mechanical force, it is almost certain that the power necessary to produce it would at least equal that which was generated by the original combustion. Man, therefore, does not create power; but availing himself of his knowledge of nature's mysteries, he applies his talents to diverting a small and limited portion of her energies to his own wants: and, whether he employs the regulated action of steam, or the more rapid and tremendous effects of gunpowder, he is only producing on a small scale compositions and decompositions which nature is incessantly at work in reversing, for the restoration of that equilibrium which we cannot doubt is constantly maintained throughout even the remotest limits of our system. The operations of man participate in the character of their Author; they are diminutive, but energetic during the short period of their existence: whilst those of nature, acting over vast spaces, and unlimited by time, are ever pursuing their silent and resistless career.

17. In stating the broad principle, that all combinations of mechanical art can only augment the force communicated to the machine at the expense of the time employed in producing the effect, it might perhaps be imagined that the assistance derived from such contrivances is small. This is, however, by no means the case; since the almost unlimited variety they afford enables us to exert to the greatest advantage whatever force we employ. There is, it is true, a limit beyond which it is impossible to reduce the power necessary to produce any given effect, but it very seldom happens that the methods first employed at all approach that limit. In dividing the knotted root of a tree for the purposes of fuel, how very different will be the time consumed, according to the nature of the tool made use of! The hatchet, or the adze, will divide it into small parts, but will consume a large portion of the workman's time. The saw will answer the same purpose more effectually and more quickly. This, in its turn, is superseded by the wedge, which rends it in a still shorter time. If the circumstances are favorable, and the workman skilful, the time and expense may be still farther reduced by the use of a small quantity of gunpowder exploded in holes judiciously placed in the block.

18. When a mass of matter is to be removed, a certain force must be expended; and upon the proper economy of this force the price of transport will depend. A country must, however, have reached a high degree of civilization before it will have approached the limit of this economy. The cotton of Java is conveyed in junks to the coast of China; but from the seed not being previously separated, three-quarters of the weight thus carried is not cotton. This might, perhaps, be justified in Java by the want of machinery to separate the seed, or by the relative cost of the operation in the two countries. But the cotton itself, as packed by the Chinese, occupies three times the bulk of an equal quantity shipped by Europeans for their own markets. Thus the freight of a given quantity of cotton costs the Chinese nearly twelve times the price to which, by a proper attention to mechanical methods, it might be reduced.*

ACCUMULATING POWER.

19. Whenever the work to be done requires more force for its execution than can be gene-

* Crawfurd's Indian Archipelago.

rated in the time necessary for its completion, recourse must be had to some mechanical method of preserving and condensing a part of the power exerted previously to the commencement of the process. This is most frequently accomplished by a fly-wheel, which is in fact nothing more than a wheel having a very heavy rim, so that the greater part of its weight is near the circumference. It requires great power applied for some time to put this into rapid motion; but when moving with considerable velocity, the effects are exceedingly powerful, if its force be concentrated upon a small object. In some of the iron works where the power of the steam-engine is a little too small for the rollers which it drives, it is usual to set the engine at work a short time before the red-hot iron is ready to be removed from the furnace to the rollers, and to allow it to work with great rapidity until the fly has acquired a velocity rather alarming to those unused to such establishments. On passing the softened mass of iron through the first groove, the engine receives a great and very perceptible check; and its speed is diminished at the next and at each succeeding passage, until the iron bar is reduced to such a size that the ordinary power of the engine is sufficient to roll it.

20. The powerful effect of a large fly-wheel, when its force can be concentrated in a point, was curiously illustrated at one of the largest of our manufactories. The proprietor was showing to a friend the method of punching holes in iron plates for the boilers of steam-engines. He held in his hand a piece of sheet-iron, three-eighths of an inch thick, which he placed under the punch. Observing, after several holes had been made, that the punch made its perforations more and more slowly, he called to the engine-man to know what made the engine work so sluggishly, when it was found that the fly-wheel and punching apparatus had been detached from the steam-engine just at the commencement of his experiment.

21. Another mode of accumulating power arises from lifting a weight and then allowing it to fall. A man, even with a heavy hammer, might strike repeated blows upon the head of a pile without producing any effect. But if he raises a much heavier hammer to a much greater height, its fall, though far less frequently repeated, will produce the desired effect.

REGULATING POWER.

22. Uniformity and steadiness in the rate in which machinery works are essential both for its effect and its duration. That beautiful contrivance, the governor of the steam-engine, must immediately occur to all who are familiar with that admirable machine. Wherever the increased speed of an engine would lead to injurious or dangerous consequences, it is applied; and is equally the regulator of the water-wheel which drives a spinning-jenny, or of the wind-mills which drain our fens. In the dock-yard at Chatham, the descending motion of a large platform, on which timber is raised, is regulated by a governor; but as the weight is very considerable, the velocity of this governor is still farther checked by causing its motion to take place in water.

The regularity of the supply of fuel to the fire under the boilers of steam-engines is another mode of contributing to the uniformity of their rate, and also economizes the consumption of coal. Several patents have been taken out for methods of regulating this supply: the general principle being to make the engine supply the fire by means of a hopper, with small quantities of fuel at regular intervals, and to diminish this supply when it works quickly. One of the incidental advantages of this plan is, that by throwing on a very small quantity of coal at a time, the smoke is almost entirely consumed. The dampers of ash-pits and chimneys are also, in some cases, connected with machines in order to regulate their speed.

23. Another contrivance for regulating the effect of machinery consists in a vane or a fly, of little weight, but presenting a large surface. This revolves rapidly, and soon acquires a uniform rate, which it cannot greatly exceed, because any addition to its velocity produces a much greater addition to the resistance it meets with from the air. The interval between the strokes on the bell of a clock is regulated by this means; and the fly is so contrived, that this interval may be altered by presenting the arms of it more or less obliquely to the direction in which they move. This kind of fly, or vane, is generally used in the smaller kinds of mechanism, and, unlike the heavy fly, it is a destroyer instead of a preserver of force. It is the regulator used in musical boxes, and in almost all mechanical toys.

24. Another very beautiful contrivance for regulating the number of strokes made by a steam-engine, is used in Cornwall: it is called the *cataract*, and depends on the time required to fill a vessel plunged in water, the opening of the valve through which the fluid is admitted being adjustable at the will of the engine-man.

INCREASE AND DIMINUTION OF VELOCITY.

25. The fatigue produced on the muscles of the human frame does not altogether depend on the actual force employed in each effort, but partly on the frequency with which it is exerted. The exertion necessary to accomplish every operation consists of two parts: one of these is the expenditure of force which is necessary to drive the tool or instrument; and the other is the effort required for the motion of some limb of the animal producing the action. If we take, as an example, the act of driving a nail into a piece of wood, the first of these is the *propelling* the hammer head against the nail; the other is, *raising* the arm in order to lift the hammer. If the weight of the hammer is considerable, the former part will cause the great-

est portion of the exertion. If the hammer is light, the exertion of *raising* the arm will produce the greatest part of the fatigue. It does, therefore, happen that operations requiring very trifling force, if frequently repeated, will tire more effectually than more laborious work. There is also a degree of rapidity beyond which the action of the muscles cannot be pressed.

26. The most advantageous load for a porter who carries wood up stairs on his shoulders, has been investigated by M. Coulomb; but he found from experiment that a man walking up stairs without any load, and raising his burden by means of his own weight in descending, could do as much work in one day as four men employed in the ordinary way with the most favorable load.

27. The proportion between the velocity with which men or animals move, and the weights they carry, is a matter of considerable importance, particularly in military affairs. It is also of great importance for the economy of labor, to adjust the weight of that part of the animal's body which is moved, the weight of the tool it urges, and the frequency of repetition of these efforts, so as to produce the greatest effect. An instance of the saving of time, by making the same motion of the arm execute two operations instead of one, occurs in the simple art of making the tags of boot-laces: they are formed out of very thin, tinned, sheet-iron, and were formerly cut out of long strips of that material into pieces of such a breadth that when bent round they just enclosed the lace. Two pieces of steel have recently been fixed to the side of the shears, by which each piece of tinned-iron, as soon as it is cut, is bent into a semi-cylindrical form. The additional power required for this operation is almost imperceptible; and it is executed by the same motion of the arm which produces the cut. The work is usually performed by women and children, and with the improved tool more than three times the quantity of tags is produced in a given time.*

Whenever the work is itself light, it becomes necessary, in order to economize time, to increase the velocity. Twisting the fibres of wool by the fingers would be a most tedious operation: in the common spinning-wheel the velocity of the foot is moderate, but by a very simple contrivance that of the thread is most rapid. A piece of cat-gut passing round a large wheel, and then round a small spindle, effects this change. This contrivance is common to a multitude of machines, some of them very simple. In large shops for the retail of ribands, it is necessary at short intervals to "take stock," that is, to measure and re-wind every piece of riband, an operation which, even with this mode of shortening it, is sufficiently tiresome, but without it would be almost impossible from its expense. The small balls of sewing-cotton, so cheap and so beautifully wound, are formed by a machine on the same principle, and but a few steps more complicated.

28. In turning from the smaller instruments in frequent use to the larger and more important machines, the economy arising from the increase of velocity becomes more striking. In converting cast into wrought iron, a mass of metal of about a hundred weight is heated almost to a white heat, and placed under a heavy hammer moved by water or steam power. This is raised by a projection on a revolving axis; and if the hammer derived its momentum only from the space through which it fell, it would require a considerably greater time to give a blow. But as it is important that the softened mass of red hot iron should receive as many blows as possible before it cools, the form of the cam or projection on the axis is such, that, the hammer, instead of being lifted to a small height, is thrown up with a jerk, and almost the instant after it strikes against a large beam, which acts as a powerful spring, and drives it down on the iron, with such velocity that by these means about double the number of strokes can be made in a given time. In the smaller tilt-hammers, this is carried still farther: by striking the tail of the tilt-hammer forcibly against a small steel anvil, it rebounds with such velocity that from three to five hundred strokes are made in a minute.

29. In the manufacture of scythes, the length of the blade renders it necessary that the workman should move readily, so as to bring every part on the anvil in quick succession. This is effected by placing him in a seat suspended by ropes from the ceiling: so that he is enabled, with little bodily exertion, by pressing his feet against the block which supports the anvil, to vary his distance to any required extent. In the manufacture of anchors, an art in which this contrivance is of still greater importance, it has only been recently applied.

30. The most frequent reason for employing contrivances for diminishing velocity arises from the necessity of overcoming great resistances with small power. Systems of pulleys, the crane, and many other illustrations, might also here be adduced; but they belong more appropriately to some of the other causes, which we have assigned for the advantages of machinery. The common smoke-jack is an instrument in which the velocity communicated is too great for the purpose required: and it is transmitted through wheels which reduce it to a more moderate rate.

EXTENDING THE TIME OF ACTION OF FORCES.

31. This is one of the most common and most useful of the employments of machinery. The half minute which we daily devote to the winding up of our watches is an exertion of labor almost insensible, yet by the aid of a few wheels its effect is spread over the whole twenty-four hours. In our clocks, this extension of the time of action of the original force impressed is

* Transactions of the Society of Arts, 1826.

carried still farther; the better kind usually require winding up once in eight days, and some are occasionally made to continue in action during a month or even a year. Another familiar illustration may be noticed in our domestic furniture; the common jack, by which our meat is roasted, is a contrivance to enable the cook in a few minutes to exert a force which the machine retails out during the succeeding hour in turning the loaded spit, thus enabling her to bestow her undivided attention on the other important duties of her vocation. A great number of automatons, and mechanical toys moved by springs, may be classed under this division.

32. A small moving power, in the shape of a jack or a spring with a train of wheels, is often of great convenience to the experimental philosopher, and has been used with advantage in magnetic and electric experiments, where the rotation of a disk of metal or other body is necessary, thus allowing to the inquirer the unimpeded use of both his hands. A vane connected by a train of wheels, and set in motion by a heavy weight, has also on some occasions been employed in chemical processes, to keep a solution in a state of agitation. Another object, to which a similar apparatus may be applied, is the polishing of small specimens of minerals for optical experiments.

SAVING TIME IN NATURAL OPERATIONS.

33. The process of tanning will furnish us with a striking illustration of the power of machinery in accelerating certain processes in which natural operations have a principal effect. The object of this art is to combine a certain principle called *tanning* with every particle of the skin to be tanned. This in the ordinary process is accomplished by allowing the skins to soak in pits containing a solution of tanning matter: they remain in the pits six, twelve, or eighteen months; and in some instances, (if the hides are very thick,) they are exposed to the operation for two years, or even during a longer period. This length of time is apparently required in order to allow the tanning matter to penetrate into the interior of a thick hide. The improved process consists in placing the hides with the solution of tan in close vessels, and then exhausting the air. The consequence of this is to withdraw any air which might be contained in the pores of the hides, and to employ the pressure of the atmosphere to aid capillary attraction in forcing the tan into the interior of the skins. The effect of the additional force thus brought into action can be equal only to one atmosphere, but a farther improvement has been made: the vessel containing the hides is, after exhaustion, filled up with a solution of tan; a small additional quantity is then injected with a forcing-pump. By these means any degree of pressure may be given which the containing vessel is capable of supporting; and it has been found that, by employing such a method, the thickest hides may be tanned in six weeks or two months.

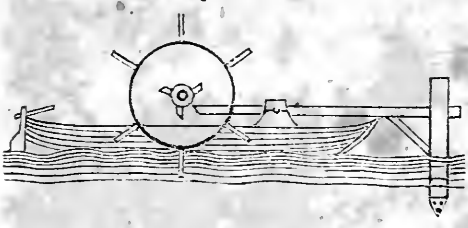
34. The same process of injection might be applied to impregnate timber with tar, or any other substance adapted to preserve it from decay; and if it were not too expensive, the deal floors of houses might thus be impregnated with alumine or other substances, which would render them much less liable to be accidentally set on fire. Some idea of the quantity of matter which can be injected into wood, by great pressure, may be formed from considering the fact stated by Mr. Scoresby, respecting an accident which occurred to a boat of one of our whaling-ships. The line of the harpoon being fastened to it, the whale in this instance dived directly down, and carried the boat along with him. On returning to the surface the animal was killed, but the boat, instead of rising, was found suspended beneath the whale by the rope of the harpoon; and on drawing it up, every part of the wood was found to be so completely saturated with water as to sink immediately to the bottom.

35. The operation of bleaching linen in the open air is one for which considerable time is necessary; and although it does not require much labor, yet, from the risk of damage and of robbery from long exposure, a mode of shortening the process was highly desirable. The method now practised, although not mechanical, is such a remarkable instance of the application of science to the practical purposes of manufactures, that in mentioning the advantages derived from shortening natural operations, it would have been scarcely pardonable to have omitted all allusion to the beautiful application of chlorine, in combination with lime, to the art of bleaching.

36. Another instance more strictly mechanical occurs in some countries where fuel is expensive, and the heat of the sun is not sufficient to evaporate the water from brine springs. The water is first pumped up to a reservoir, and then allowed to fall in small streams through faggots. Thus it becomes divided; and, presenting a large surface, evaporation is facilitated, and the brine which is collected in the vessels below the faggots is stronger than that which was pumped up. After thus getting rid of a large part of the water, the remaining portion is driven off by boiling. The success of this operation depends on the circumstance of the atmosphere not being saturated with moisture: if the air, at the time the brine falls through the faggots, holds in solution as much moisture as it can contain in an invisible state, none can be absorbed from the salt water, and the labor expended in pumping is entirely wasted. The state of the air, as to dryness, is therefore an important consideration in fixing the time when this operation is to be performed; and an attentive examination of its state, by means of the hygrometer, might be productive of some economy of labor.

37. In some countries, where wood is scarce, the evaporation of salt water is carried on by a large collection of ropes, which are stretched perpendicularly. The water passing down them deposites the sulphate of lime which it held in solution, and gradually incrusts the ropes, so that in the course of twenty years, when they are nearly rotten, they are sustained by the surrounding incrustation, thus presenting the appearance of a vast collection of small columns.

38. Amongst natural operations perpetually altering the surface of our globe, there are some which it would be advantageous to accelerate. The wearing down of the rocks which impede the rapids of navigable rivers is one of this class. A very beautiful process for accomplishing this object has been employed in America. A boat is placed at the bottom of the rapid, and kept in its position by a long rope, which is firmly fixed on the bank of the river near the top. An axis, having a wheel similar to the paddle-wheel of a steamboat fixed at each end of it, is placed across the boat; so that the two wheels and their connecting axis shall revolve rapidly, being driven by the force of the passing current. Let us now imagine several beams of wood shod with pointed iron fixed at the ends of strong levers, projecting beyond the bow of the boat, as in the annexed representation:



If these levers are at liberty to move up and down, and if one or more projecting pieces, called cams, are fixed on the axis opposite to the end of each lever, the action of the stream upon the wheels will keep up a perpetual succession of blows. The sharp-pointed shoe, striking upon the rock at the bottom, will continually detach small pieces, which the stream will immediately carry off. Thus, by the mere action of the river itself, a constant and most effectual system of pounding the rock at its bottom is established. A single workman may, by the aid of a rudder, direct the boat to any required part of the stream; and when it is necessary to move up the rapid, as the channel is cut, he can easily cause the boat to advance by means of a capstan.

39. When the object of the machinery just described has been accomplished, and the channel is sufficiently deep, a slight alteration converts the apparatus to another purpose almost equally advantageous. The stampers and the projection pieces on the axis are removed, and a barrel of wood or metal, surrounding part of the axis, and capable, at pleasure, of being connected with or disconnected from the axis itself, is substituted. The rope which hitherto fastened the boat is now fixed to this barrel; and if the barrel is loose upon the axis, the paddle-wheels make the axis only revolve, and the boat remains in its place: but the moment the axis is attached to its surrounding barrel, this begins to turn, and winding the rope upon itself, the boat is gradually drawn up against the stream, and may be employed as a kind of tug-boat for all the vessels which have occasion to ascend the rapid. When the tug-boat reaches the summit, the barrel is released from the axis, and friction being applied to moderate its velocity, the boat is allowed to descend.

EXERTING FORCES TOO GREAT FOR HUMAN POWER, AND EXECUTING OPERATIONS TOO DELICATE FOR HUMAN TOUCH.

40. It requires some skill and a considerable apparatus to enable many men to exert their whole force at a given point, and when this number amounts to hundreds or to thousands, additional difficulties present themselves. If ten thousand men were hired to act simultaneously, it would be exceedingly difficult to discover whether each exerted his whole force, and, consequently, to be assured that each man did the duty for which he was paid. And if still larger bodies of men or animals were necessary, not only would the difficulty of directing them become greater, but the expense would increase from the necessity of transporting food for their subsistence.

The difficulty of enabling a large number of men to exert their force at the same instant of time has been almost obviated by the use of sound. The whistle of the boatswain occasionally performs this service; and in removing, by manual force, the vast mass of granite, weighing above 1400 tons, on which the equestrian figure of Peter the Great is placed at St. Petersburg, a drummer was always stationed on its summit to give the signal for the united efforts of the workmen.

An interesting discovery was made a few years since, by Champollion, of an ancient Egyptian drawing, in which a multitude of men appeared harnessed to a huge block of stone, on the top of which stood a single individual with his hands raised above his head, apparently in the act of clapping them, for the same purpose of insuring the exertion of their combined force at the same moment of time.

41. In all our larger manufactories numerous instances occur of the application of the power of steam to overcome resistances which it would require far greater expense to surmount by means of animal labor. The twisting of the largest cables, the rolling, hammering, and cutting large masses of iron, the draining of our mines, all require enormous exertions of physical force continued for considerable periods of time. Other means are had recourse to

when the force required is great, and the space through which it is to act is small. The hydraulic press of Bramah can, by the exertion of one man, produce a pressure of 1500 atmospheres, and with such an instrument a hollow cylinder of wrought iron, three inches thick, has been burst. In riveting together the iron plates out of which steam engine boilers are made, it is necessary to produce as close a joint as possible. This is accomplished by using the rivets red-hot; while they are in that state the two plates of iron are rivetted together, and the contraction which the rivet undergoes in cooling draws them together with a force which is only limited by the tenacity of the metal of which the rivet itself is made.

42. It is not alone in the greater operations of the engineer or the manufacturer, that those vast powers which man has called into action, in availing himself of the agency of steam, are fully developed. Wherever the individual operation demanding little force for its own performance is to be multiplied in almost endless repetition, commensurate power is required. It is the same "giant arm which twists the largest cable," that spins from the cotton plant an "almost gossamer thread." Obedient to the hand which called into action its resistless powers, it contends with the ocean and the storm, and rides triumphantly through dangers and difficulties unattempted by the older modes of navigation. It is the same engine that, in its more regulated action, weaves the canvass it may one day supersede; or, with almost fairy fingers, entwines the meshes of the most delicate fabric that adorns the female form.*

43. The Fifth Report of the Select Committee of the House of Commons on the Holyhead Roads furnishes ample proof of the great superiority of steam vessels. The following extracts are taken from the evidence of Captain Rogers, the commander of one of the packets:

"*Question.*—Be so good as to acquaint the Committee in what manner the communication has been kept open between Holyhead and Dublin by steam packets, and what has been the success of the experiment of establishing them on that station.

"*Answer.*—We have done every thing that could be done, *by steamboats;* and they will go, no doubt, when a sailing vessel will not—that has been proved.

"*Question.*—Are you not perfectly satisfied, from the experience you have had, that the steam vessel you command is capable of performing what no sailing vessel can do?

"*Answer.*—Yes.

"*Question.*—During your passage from Gravesend to the Downs, could any square-rigged vessel, from a first-rate down to a sloop of war, have performed the voyage you did in the time you did it in the steamboat?

"*Answer.*—No; it was impossible. In the Downs we passed several Indiamen, and 150 sail, there, that could not move down the Channel; and at the back of Dungeness we passed 120 more.

"*Question.*—At the time you performed that voyage, with the weather you have described, from the Downs to Milford, if that weather had continued twelve months, would any square-rigged vessel have performed it?

"*Answer.*—They would have been a long time about it; probably would have been weeks instead of days. A sailing vessel would not have beat up to Milford, as we did, in twelve months."

44. The process of printing on silver paper, which is necessary for bank-notes, is attended with some inconvenience, from the necessity of damping the paper previously to taking the impression. It was difficult to do this uniformly; and in the process of dipping a parcel of several sheets together into a vessel of water, the outside sheets becoming much more wet than the others, were very apt to be torn. A method has been adopted at the Bank of Ireland which obviates this inconvenience. The whole quantity of paper to be damped is placed in a close vessel, from which the air is exhausted; water is then admitted, and every leaf is completely wetted; the paper is then removed to a press, and all the superfluous moisture is squeezed out.

REGISTERING OPERATIONS.

45. One of the most singular advantages we derive from machinery is in the check which it affords against the inattention, the idleness, or the knavery, of human agents. Few occupations are more wearisome than counting a series of repetitions of the same fact; the number of paces we walk affords a tolerably good measure of distance passed over, but the value of this is much enhanced by possessing an instrument, the pedometer, which will count for us the number of steps we have made. A piece of mechanism of this kind is sometimes applied to count the number of turns made by the wheel of a carriage, and thus to indicate the distance travelled: an instrument similar in its object, but differing in its construction, has been used for counting the number of strokes made by a steam-engine, and the number of coins struck in a press. One of the simplest instruments for counting any series of operations was contrived by Mr. Donkin.*

46. Another instrument for registering is used in some establishments for calendering and embossing. Many hundred thousand yards of calico and stuffs pass weekly through these operations, and as the price paid for the process is small, the value of the time spent in measur-

* The importance and diversified applications of the steam engine were most ably enforced in the speeches made at a public meeting, held (June, 1824) for the purpose of proposing the erection of a monument to the memory of James Watt; these were subsequently printed.

* Transactions of the Society of Arts, 1819, p. 116.

ing them would bear a considerable proportion to the profit. A machine has, therefore, been contrived for measuring and registering the length of the goods as they pass rapidly through the hands of the operator, and all chance of erroneous counting is thus avoided.

47. Perhaps the most useful contrivance of this kind is one for ascertaining the vigilance of a watchman. It is a piece of mechanism connected with a clock placed in an apartment to which the watchman has not access, but he is ordered to pull a string situated in a certain part of his round once in every hour. The instrument, aptly called a *tell-tale*, informs the owner whether the man has missed any, and what hours during the night.

48. It is often of great importance, both for regulations of excise as well as for the interests of the proprietor, to know the quantity of spirits or of other liquors which have been drawn off by those persons who are allowed to have access to the vessels during the absence of the inspectors or principals. This may be accomplished by a peculiar kind of stopcock, which will, at each opening, only discharge a certain measure of fluid,—the number of times the cock has been turned being registered by a counting apparatus, accessible only to the master.

49. The time and labor consumed in guaging casks partly filled has led to an improvement, which, by the simplest means, obviates a considerable inconvenience, and enables any person to read off, on a scale, the number of gallons contained in any vessel, as readily as he does the degree of heat indicated by his thermometer. A small stop-cock is inserted near the bottom of the cask, which it connects with a glass tube of narrow bore fixed to a scale on the side of the cask, and rising a little above its top. The plug of the cock may be turned into three positions: in the first it cuts off all communication with the cask; in the second, it opens a communication between the cask and the glass tube; and, in the third, it cuts off the connection between the cask and the tube, and opens a communication between the tube and any vessel held beneath the cock to receive its contents. The scale of the tube is graduated by opening the communication between the cask and tube, and pouring into the cask a gallon of water. A line is then drawn on the scale opposite the place in the tube to which the water rises. This operation is repeated, and at each successive gallon a new line is drawn. Thus the scale being formed by actual measurement,* both the proprietor and the excise officer see, on inspection, the contents of each cask, and the tedious process of guaging is altogether dispensed with. Other advantages accrue from this simple contrivance, in the great economy of time which it produces in making mixtures of different spirits in taking stock, and in receiving spirit from the distiller.

50. The gas-meter, by which the quantity of gas used by each consumer is ascertained, is another instrument of this kind. They are of several forms, but all of them intended to register the number of cubic feet of gas which has been delivered. It is very desirable that these meters should be obtainable at a moderate price, and that every consumer should employ them; because, by making each purchaser pay only for what he consumes, and by preventing that extravagant waste of gas which we frequently observe, the manufacturer of gas will be enabled to make an equal profit at a diminished price to the consumer.

51. The sale of water, by the different companies in London, might also, with advantage, be regulated by a different kind of meter. If such a system were adopted, much water which is now allowed to run to waste would be saved, and an unjust inequality between the rates charged on different houses by the same company be avoided.

52. Another subject to which machinery for registering operations is applied with much advantage is the determination of the average effect of natural or artificial agents. The mean height of the barometer, for example, is ascertained by noting its height at a certain number of intervals during the twenty-four hours. The more these intervals are contracted, the more correctly will the mean be ascertained; but the true mean ought to participate in each momentary change which has occurred. Clocks have been proposed and made for this purpose, and the principle adopted has been that of moving a sheet of paper, slowly and uniformly, before a pencil fixed to a float upon the surface of the mercury in the cup of the barometer. Sir David Brewster proposed, several years ago, to suspend a barometer, and swing it as a pendulum. The variations in the atmosphere would thus alter the centre of oscillation, and the comparison of such an instrument with a good clock would enable us to ascertain the mean altitude of the barometer during any interval of the observer's absence.*

Instruments might also be contrived to determine the average force of traction of horses—of the wind—of a stream—or of any other irregular and fluctuating effort of animal or natural force.

53. There are several instruments contrived for awakening the attention of the observer at times previously fixed upon. The various kinds of alarums connected with clocks and watches are of this kind. In some instances it is desirable to be able to set them so as to give notice at many successive and distant

* This contrivance is due to Mr. Hennekey, of High Holborn, in whose establishment it is in constant employment.

* About seven or eight years since, without being aware of Sir David Brewster's proposal, I adapted a barometer as a pendulum to the works of a common eight-day clock; it remained in my library for several months, but I have mislaid the observations which were made.

points of time, such as those of the arrival of given stars on the meridian. A clock of this kind is used at the Royal Observatory at Greenwich.

Repeating clocks and watches may be considered as instruments for registering time, which communicate their information only when the owner requires it, by pulling a string, or by some similar application.

ECONOMY OF THE MATERIALS EMPLOYED.

54. The precision with which all operations by machinery are executed, and the exact similarity of the articles thus made, produce a degree of economy in the consumption of the raw material, which is in some cases of great importance. The earliest mode of cutting the trunks of a tree into planks was by the use of the hatchet or the adze. It might, perhaps, be first split into three or four portions, and then each portion was reduced to a uniform surface by those instruments. With such means the quantity of plank produced would probably not equal the quantity of the raw material wasted by the process; and, if the planks were thin, would certainly fall far short of it. An improved tool, the saw, completely reverses the case: in converting a tree into thick planks it causes a waste of a very small fractional part; and even in reducing it to planks of only an inch in thickness, it does not waste more than an eighth part of the raw material. When the thickness of the plank is still farther reduced, as is the case in cutting wood for veneering, the quantity of material destroyed again begins to bear a considerable proportion to that which is used; and, hence, circular saws, having a very thin blade, have been employed for such purposes. In order to economize still farther the more valuable woods, Mr. Brunel contrived a machine which, by a system of blades, cuts off the veneer in a continuous shaving, thus rendering the whole of the piece of timber available.

55. The rapid improvements which have taken place in the printing press during the last twenty years afford another instance of saving in the materials consumed, which is interesting from its connection with literature, and valuable because admitted and well ascertained by measurement. In the old method of inking type, by large hemispherical balls, stuffed and covered with leather, the printer, after taking a small portion of ink from the ink-block, was continually rolling them in various directions against each other, in order that a thin layer of ink might be uniformly spread over their surface. This he again transferred to the type by a kind of rolling action. In such a process, even admitting considerable skill in the operator, it could not fail to happen that a large quantity of ink should get near the edges of the balls, which, not being transferred to the type, became hard and useless, and was taken off in the form of a thick black crust. Another inconvenience also arose—the quantity of ink spread on the block not being regulated by measure, and the number and direction of the transits of the inking-balls over each other depending on the will of the operator, and being irregular, it was impossible to place on the type a uniform layer of ink, of exactly the quantity sufficient for the impression. The introduction of cylindrical rollers of an elastic substance, formed by the mixture of glue and treacle, superseded the inking-balls, and produced considerable saving in the consumption of ink: but the most perfect economy was only to be produced by mechanism. When printing presses, moved by the power of steam, were introduced, the action of these rollers was found well adapted to the performance of the machine; and a reservoir of ink was formed, from which one roller regularly abstracted a small quantity at each impression. From three to five other rollers spread this portion uniformly over a slab, (by most ingenious contrivances varied in almost each kind of press,) and another travelling roller, having fed itself on the slab, passed and repassed over the type just before it gave the impression to the paper.

The following is an account of the results of an accurate experiment upon the effect of the process just described, made at one of the largest printing establishments in the metropolis.* Two hundred reams of paper were printed off, the old method of inking with balls being employed; two hundred reams of the same paper, and for the same book, were then printed off in the presses which inked their own type. The consumption of ink by the machine was to that by the balls as *four to nine*, or rather less than one half. In order to show that this plan of inking puts the proper quantity of ink upon the type, we must prove, first,—that it is not too little: this would soon have been discovered from the complaints of the public and the booksellers; and, secondly,—that it is not too much. This latter point is satisfactorily established by a reference to the frequency of the change of what is called the *set-off sheet*, in the old method. A few hours after one side of a sheet of paper has been printed upon, the ink is sufficiently dry to allow it to receive the impression upon the other; and, as considerable pressure is made use of, the tympan on which the side first printed is laid, is guarded from soiling it by a sheet of paper called the *set-off sheet*. This paper receives in succession every sheet of the work to be printed, and acquires from them more or less of the ink, according to their dryness, or the quantity upon them. It was necessary in the former process, after about one hundred impressions, to change the *set-off sheet*, which in that time became too much soiled for farther use. In the new method of printing by machinery, no *set-off sheet* is used, but a blanket

* This experiment was made at the establishment of Mr. Clowes, in Stamford street.

is employed as its substitute; this does not require changing above once in five thousand impressions, and instances have occurred of its remaining sufficiently clean for twenty thousand. Here, then, is a proof that the quantity of superfluous ink put upon the paper in machine-printing is so small, that if multiplied by five thousand, and in some instances even by twenty thousand, it is only sufficient to render useless a single piece of clean cloth.*

OF THE IDENTITY OF THE WORK WHEN IT IS OF THE SAME KIND, AND ITS ACCURACY WHEN OF DIFFERENT KINDS.

56. Nothing is more remarkable, and yet less unexpected, than the perfect identity of things manufactured by the same tool. If the top of a circular box is to be made to fit over the lower part, it may be done in the lathe by gradually advancing the tool of the sliding-rest; the proper degree of tightness between the box and its lid being found by trial. After this adjustment, if a thousand boxes are made, no additional care is required; the tool is always carried up to the stop, and each box will be equally adapted to every lid. The same identity pervades all the arts of printing; the impressions from the same block, or the same copperplate, have a similarity which no labor could produce by hand. The minutest traces are transferred to all the impressions, and no omission can arise from the inattention or unskilfulness of the operator. The steel punch, with which the card-wadding for a fowling-piece is cut, if it once perform its office with accuracy, constantly reproduces the same exact circle.

57. The accuracy with which machinery executes its work is, perhaps, one of its most important advantages; it may, however, be contended, that a considerable portion of this advantage may be resolved into saving of time, for it generally happens, that any improvement in tools increases the quantity of work done in a given time. Without tools, that is, by the mere efforts of the human hand, there are, undoubtedly, multitudes of things which it would be impossible to make. Add to the human hand the rudest cutting instrument, and its powers are enlarged; the fabrication of many things then becomes easy, and that of others possible with great labor. Add the saw to the knife or the hatchet, and other works become possible, and a new course of difficult operations is brought into view, whilst many of the former are rendered easy. This observation is applicable even to the most perfect tools or machines. It would be *possible* for a very skilful workman, with files and polishing substances, to form a cylinder out of a piece of steel; but the time which this would require would be so considerable, and the number of failures would probably be so great, that for all practical purposes such a mode of producing a steel cylinder might be said to be impossible. The same process, by the aid of the lathe and the sliding-rest, is the every-day employment of hundreds of workmen.

58. Of all the operations of mechanical art, that of turning is the most perfect. If two surfaces are worked against each other, whatever may have been their figure at the commencement, there exists a tendency in them both to become portions of spheres. Either of them may become convex, and the other concave, with various degrees of curvature. A plane surface is the line of separation between convexity and concavity, and is most difficult to hit; and it is more easy to make a good circle than to produce a straight line. A similar difficulty takes place in figuring specula for telescopes; the parabola is the surface which separates the hyperbolic from the elliptic figure, and is the most difficult to form. If a spindle, not cylindrical at its end, is pressed into a hole not circular, and if the spindle be kept constantly turning, there is a tendency in these two bodies so situated to become conical, or to have circular sections. If a triangular pointed piece of iron be worked round in a circular hole, the edges will gradually wear, and it will become conical. These facts, if they do not explain, at least illustrate the principles on which the excellence of work formed in the lathe depends.

OF COPYING.

59. The two last sources of excellence in the work produced by machinery depend on a principle which pervades a very large portion of all manufactures, and is one upon which the cheapness of the articles produced seems greatly to depend. The principle alluded to is that of COPYING, taken in its most extensive sense. Almost unlimited pains are, in some instances, bestowed on the original, from which a series of copies is to be produced; and the larger the number of these copies, the more care and pains can the manufacturer afford to lavish upon the original. It may thus happen, that the instrument or tool actually producing the work shall cost five or even ten thousand times the price of each individual specimen of its power.

As the system of copying is of so much importance, and of such extensive use in the arts, it will be convenient to classify a considerable number of those processes in which it is employed. The following enumeration is not offered as a complete list; and the explanations are restricted to the shortest possible detail which is consistent with a due regard to making the subject intelligible. Operations of copying are effected under the following circumstances:

By printing from cavities.	By stamping.
By printing from surface.	By punching.
By casting.	With elongation.
By moulding.	With altered dimensions.

OF PRINTING FROM CAVITIES.

60. The art of printing, in all its numerous

* In the very best kind of printing, it is necessary, in the old method, to change the set-off sheet once in twelve times. In printing the same kind of work by machinery the blanket is changed once in 2000.

departments, is essentially an art of copying. Under its two great divisions, printing from hollow lines, as in copper-plate, and printing from surface, as in block printing, are comprised numerous arts.

61. *Copper-plate Printing.*—In this instance the copies are made by transferring to paper, by means of pressure, a thick ink, from the hollows and lines cut in the copper. An artist will sometimes exhaust the labor of one or two years upon engraving a plate, which will not, in some cases, furnish above five hundred copies in a state of perfection.

62. *Engraving on Steel.*—This is an art in most respects similar to engraving on copper, except that the number of copies is far less limited. A bank note engraved as a copper-plate will not give above three thousand impressions without a sensible deterioration. Two impressions of a bank note engraved on steel were examined by one of our most eminent artists,* who found it difficult to pronounce with any confidence which was the earliest impression. One of these was a proof from amongst the first thousand, the other was taken after between seventy and eighty thousand had been printed off.

63. *Music Printing.*—Music is usually printed from pewter-plates, on which the characters have been impressed by steel punches. The metal being much softer than copper is liable to scratches, which detain a small portion of the ink. This is the reason of the dirty appearance of printed music. A new process has recently been invented by Mr. Cowper, by which this inconvenience will be avoided. The improved method, which gives sharpness to the characters, is still an art of copying; but it is effected by surface-printing, nearly in the same manner as calico-printing, from blocks, to be described hereafter, (70.) The method of printing music from pewter-plates, although by far the most frequently made use of, is not the only one employed, for music is occasionally printed from stone. Sometimes also it is printed with moveable type; and occasionally the musical characters are printed on the paper, and the lines printed afterwards. Specimens of both these latter modes of music printing may be seen in the splendid collection of impressions from the types of the press of Bodoni at Parma: but notwithstanding the great care bestowed on the execution of that work, the perpetual interruption of continuity in the lines, arising from the use of moveable type, when the characters and lines are printed at the same time, is apparent.

64. *Calico-Printing from Cylinders.*—Many of the patterns on printed calicoes are copies by printing from copper cylinders about four or five inches in diameter, on which the desired pattern has been previously engraved. One portion of the cylinders is exposed to the ink, whilst an elastic scraper of stuffed leather, by being pressed forcibly against another part removes all superfluous ink from the surface previously to its reaching the cloth. A piece of calico twenty-eight yards in length rolls through this press, and is printed in four or five minutes.

65. *Printing from perforated Sheets of Metal, or Stencilling.*—Very thin brass is sometimes perforated in the form of letters, usually those of a name; this is placed on any substance which it is required to mark, and a brush dipped in paint is passed over the brass. Those parts which are cut away admit the paint, and thus a copy of the name appears on the substance below. This method, which affords rather a coarse copy, is sometimes used for paper with which rooms are covered, and more especially for the borders. If a portion is required to match an old pattern, this is, perhaps, the most economical way of producing it.

66. The beautiful red cotton handkerchiefs dyed at Glasgow have their pattern given to them by a process similar to this, except that, instead of *printing* from a pattern, the reverse operation—that of *discharging* a part of the color from a cloth already dyed—is performed. A number of handkerchiefs are pressed with very great force between two plates of metal, which are similarly perforated with round or lozenge-shaped holes, according to the intended pattern. The upper plate of metal is surrounded by a rim, and a fluid which has the property of discharging the red dye is poured upon that plate. This liquid passes through the holes in the metal, and also through the calico; but, owing to the great pressure opposite all the parts of the plates not cut away, it does not spread itself beyond the pattern. After this the handkerchiefs are washed, and the pattern of each is a copy of the perforated metal plate used in the process.

OF PRINTING FROM SURFACE.

This second department, of printing from surface, is of more frequent application in the arts than that which has just been considered.

67. *Printing from wooden Blocks.*— A block of box wood is in this instance the substance out of which the pattern is formed: the design being sketched upon it, the workman cuts away with sharp tools every part except the lines to be represented in the impression. This is exactly the reverse of the process of engraving on copper, in which every line to be represented is cut away. The ink, instead of filling the cavities cut in the wood, is spread upon the surface which remains, and is thence transferred to the paper.

68. *Printing from moveable Types.*—This is the most important in its influence, of all the arts of copying. It possesses a singular peculiarity in the immense subdivision of the parts that form the pattern. After that pattern has furnished thousands of copies, the same individual elements may be arranged again and

* The late Mr. Lowry.

again in other forms, and thus supply multitudes of originals, from each of which thousands of their copied impressions may flow.

69. *Printing from Stereotype.*—This mode of producing copies is very similar to the preceding; but as the original pattern is incapable of change, it is only applied to cases where an extraordinary number of copies are demanded, or where the work consists of figures, and it is of great importance to insure accuracy. Alterations may be made in it from time to time; and thus mathematical tables may, by the gradual extirpation of error, at last become perfect. This mode of producing copies possesses, in common with that by moveable types, the advantage of being capable of use in conjunction with wood cuts, a union frequently of considerable importance, and which is not so readily accomplished with engravings on copper.

70. *Calico-Printing from Blocks.*—This is a mode of copying, by surface-printing, from the ends of small pieces of copper wire, of various forms, fixed into a block of wood. They are all of one uniform height, about the eighth part of an inch above the surface of the wood, and are arranged by the maker into any required pattern. If the block be placed upon a piece of fine woollen cloth, on which ink of any color has been uniformly spread, the projecting copper wires receive a portion, which they give up when applied to the calico to be printed. By the former method of printing on calico, only one color could be used; but by this plan, after the flower of a rose, for example, has been printed with one set of blocks, the leaves may be printed of another color by a different set.

71. *Printing Oil-Cloth.*—After the canvass, which forms the basis of oil-cloth, has been covered with paint of one uniform tint, the remainder of the processes which it passes through is a series of copyings by surface-printing, from patterns formed upon wooden blocks very similar to those employed by the calico printer. Each color requires a distinct set of blocks, and thus those oil-cloths with the greatest variety of colors are most expensive.

There are several other varieties of printing which we shall briefly notice as arts of copying; which, although not strictly surface-printing, yet are more allied to it than to that from copper plates.

72. *Letter Copying.*—In one of the modes of performing this process, a sheet of very thin paper is damped, and placed upon the writing to be copied. The two papers are then passed through a rolling press, and a portion of the ink from one paper is transferred to the other. The writing is of course reversed by this process; but the paper to which it is transferred being thin, it is visible on the other side, in an uninverted position. Another common mode of copying letters is by placing a sheet of paper, covered on both sides with a substance prepared from lamp-black, between a sheet of thin paper and the paper on which the letter to be despatched is to be written. If the upper or thin sheet be written upon with any hard pointed substance, the words written with this style will be impressed from the black paper upon both those adjoining it. The translucency of the upper sheet, which is retained by the writer, is in this instance necessary to render legible the writing which is on the back of the paper. Both these arts are very limited in their extent, two or three being the utmost number of repetitions they allow.

73. *Printing on China.*—This is an art of copying which is carried to a very great extent. As the surfaces to which the impression is to be conveyed are often curved, and sometimes even fluted, the ink, or paint, is first transferred from the copper to some flexible substance, such as paper, or an elastic compound of glue and treacle. It is almost immediately conveyed from this to the unbaked biscuit, to which it more readily adheres.

74. *Lithographic Printing.*—This is another mode of producing copies in almost unlimited number. The original which supplies the copies is a drawing made on a stone of a slightly porous nature; the ink employed for tracing it is made of such greasy materials that when water is poured over the stone it shall not wet the lines of the drawing. When a roller covered with printing-ink, which is of an oily nature, is passed over the stone previously wetted, the water prevents this ink from adhering to the uncovered portions; whilst the ink used in the drawing is of such a nature that the printing-ink adheres to it. In this state, if a sheet of paper be placed upon the stone, and then passed under a press, the printing-ink will be transferred to the paper, leaving the ink used in the drawing still adhering to the stone.

75. There is one application of lithographic printing which does not appear to have received sufficient attention, and perhaps farther experiments are necessary to bring it to perfection. It is the reprinting of works which have just arrived from other countries. A few years ago one of the Paris newspapers was reprinted at Brussels as soon as it arrived, by means of lithography. Whilst the ink is yet fresh this may easily be accomplished: it is only necessary to place one copy of the newspaper on a lithographic stone; and by means of great pressure applied to it in a rolling press, a sufficient quantity of the printing-ink will be transferred to the stone. By similar means, the other side of the newspaper may be copied on another stone, and these stones will then furnish impressions in the usual way. If printing from stone could be reduced to the same price per thousand as that from moveable types, this process might be adopted with great advantage for the supply of works for the use of distant countries possessing the same language: for a single copy of the work might be printed off with *transfer ink*, which is better adapted to

this purpose; and thus an English work, for example, might be published in America from stone, whilst the original, printed from moveable types, made its appearance on the same day in England.

It is much to be wished that such a method were applicable to the reprinting of fac-similes of old and scarce books. This, however, would require the sacrifice of two copies, since a leaf must be destroyed for each page. Such a method of reproducing a small impression of an old work is peculiarly applicable to mathematical tables, the setting up of which in type is always expensive, and liable to error; but how long ink will retain its power of being transferred to stone from paper on which it has been printed, must be determined by experiment. The destruction of the greasy or oily portion of the ink in the character of old books seems to present the greatest impediment: if one constituent only of the ink were removed by time, it might perhaps be hoped that chemical means would ultimately be discovered for restoring it: but if this be unsuccessful, an attempt might be made to discover some substance having a strong affinity for the carbon of the ink which remains on the paper, and very little for the paper itself.*

76. *Register Printing.*—It is sometimes thought necessary to print from a wooden block, or stereotype plate, the same pattern reversed upon the opposite side of the paper. The effect of this, which is technically called *Register Printing*, is to make it appear as if the ink had penetrated through the paper, and rendered the pattern visible on the other side. If the subject chosen contains many fine lines, it seems at first sight extremely difficult to effect so exact a super-position of the two patterns, on opposite sides of the same piece of paper, that it shall be impossible to detect the slightest deviation; yet the process is extremely simple. The block which gives the impression is always accurately brought down to the same place by means of a hinge; this spot is covered by a piece of thin leather stretched over it; the block is now inked, and being brought down to its place, gives an impression of the pattern to the leather; it is then turned back; and being inked a second time, the paper intended to be printed is placed upon the leather, when the block again descending, the upper surface of the paper is printed from the block, and its under surface takes up the impression from the leather. It is evident that the perfection of this mode of printing depends in a great measure on finding some soft substance like leather, which will take as much ink as it ought from the block, and which will give it up most completely to paper. Impressions thus obtained are usually fainter on the lower side; and in order in some measure to remedy this defect, rather more ink is put on the block at the first than at the second impression.

OF COPYING BY CASTING.

77. The art of casting, by pouring substances in a fluid state into a mould which retains them until they become solid, is essentially an art of copying; the thing produced resembling entirely, as to shape, the pattern from which it was formed.

78. *Of Casting Iron and other Metals.*—Patterns of wood or metal made from drawings are the originals from which the moulds for casting are made: so that, in fact, the casting itself is a copy of the mould, and the mould is a copy of the pattern. In castings of iron and metals for the coarser purposes, and, if they are afterwards to be worked, even for the finer machines, the exact resemblance amongst the things produced, which takes place in many of the arts to which we have alluded, is not effected in the first instance, nor is this necessary. As the metals shrink in cooling, the pattern is made larger than the intended copy; and in extricating it from the sand in which it is moulded, some little difference will occur in the size of the cavity which it leaves. In smaller works, where accuracy is more requisite, and where few or no after operations are to be performed, a mould of metal is employed which has been formed with considerable care. Thus, in casting bullets, which ought to be perfectly spherical and smooth, an iron instrument is used in which a cavity has been cut and carefully ground: and in order to obviate the contraction in cooling, a *jet* is left which may supply the deficiency of metal arising from that cause, and which is afterwards cut off. The leaden toys for children are cast in brass moulds, which open, and in which have been graved or chiseled the figures intended to be produced.

79. A very beautiful mode of representing small branches of the most delicate vegetable productions in bronze has been employed by Mr. Chantrey. A small strip of a fir-tree, a branch of holly, a curled leaf of broccoli, or any other vegetable production, is suspended by one end in a small cylinder of paper which is placed for support within a similarly formed tin case: the finest river silt, carefully separated from all the coarser particles, and mixed with water so as to have the consistency of cream, is poured into the paper cylinder by small portions at a time, carefully shaking the plant a little after each addition, in order that its leaves may be covered, and that no bubbles of air may be left. The plant and its mould are now allowed to dry, and the yielding nature of the paper allows the loamy coating to shrink from the outside. When this is dry it is surrounded by a coarser substance; and, finally, we have the twig with all its leaves imbedded in a perfect mould. This mould is carefully dried, and then gradually heated to a red heat. At the ends of some of the leaves or shoots,

* I possess a lithographic reprint of one page of a table, which appears from the form of the type, to have been several years

wires have been left to afford air-holes by their removal, and in this state of strong ignition a stream of air is directed into the hole formed by the end of the branch. The consequence is, that the wood and leaves which had been turned into charcoal by the fire, are now converted into carbonic acid by the current of air; and after some time the whole of the solid matter of which the plant consisted is completely removed, leaving a hollow mould, bearing on its interior all the minutest traces of its late vegetable occupant. When this process is completed, the mould, being still kept at nearly a red heat, receives the fluid metal, which, by its weight, either drives the very small quantity of air, which at that high temperature remains behind, out through the air-holes, or compresses it into the pores of the very porous substance of which the mould is formed.

80. *Casting in Plaster.*—This is a mode of copying applied to a variety of purposes: to produce accurate representations of the human form—of statues—or of rare fossils—to which latter purpose it has lately been applied with great advantage. In all casting, the first process is to make the mould; and plaster is the substance which is almost always employed for the purpose. The property which it possesses of remaining for a short time in a state of fluidity, renders it admirably adapted to this object, and adhesion, even to an original of plaster, is effectually prevented by oiling the surface on which it is poured. The mould formed round the subject which is copied, removed in separate pieces and then re-united, is that in which the copy is cast. This process gives additional utility and value to the finest works of art. The students of the Academy at Venice are thus enabled to admire the sculptured figures of Egina, preserved in the gallery at Munich; as well as the marbles of the Parthenon, the pride of our own Museum. Casts in plaster of the Elgin marbles adorn many of the academies of the Continent, and the liberal employment of such presents affords us an inexpensive and permanent source of popularity.

81. *Casting in Wax.*—This mode of copying, aided by proper coloring, offers the most successful imitations of many objects of natural history, and gives an air of reality to them which might deceive even the most instructed. Numerous figures of remarkable persons, having the face and hands formed in wax, have been exhibited at various times; and the resemblanees have in some instances been most striking. But whoever would see the art of copying in wax carried to the highest perfection, should examine the beautiful collection of fruit at the house of the Horticultural Society; the model of the magnificent flower of the new genus Rafflesia; the waxen models of the internal parts of the human body, which adorn the anatomical gallery of the Jardin des Plantes at Paris, and the Museum at Florence—or the collection of morbid anatomy, at the University of Bologna. The art of imitation by wax does not usually afford the multitude of copies which flow from many similar operations. This number is checked by the subsequent stages of the process, which, ceasing to have the character of copying by a tool or pattern, become consequently more expensive. In each individual production, form alone is given by casting; the coloring must be the work of the pencil, guided by the skill of the artist.

OF COPYING BY MOULDING.

82. This method of producing multitudes of individuals having an exact resemblance in external shape, is adopted very widely in the arts. The substances employed are, either naturally or by artificial preparation, in a soft or plastic state; they are then compressed by mechanical force, sometimes assisted by heat, into a mould of the required form.

83. *Of Bricks and Tiles.*—An oblong box of wood fitting upon a bottom fixed to the brickmaker's bench, is the mould from which every brick is formed. A portion of the plastic mixture of which the bricks consist is made ready by less skilful hands; the workman first sprinkles a little sand into the mould, and then throws the clay into it with some force, at the same time rapidly working it with his fingers, so as to make it completely close up to the corners. He next scrapes off, with a wetted stick, the superfluous clay, and shakes the new-formed brick dexterously out of its mould upon a piece of board, on which it is removed by another workman to the place appointed for drying it. A very skilful moulder has, occasionally, in a long summer's day, delivered from ten to eleven thousand bricks; but a fair average day's work is from five to six thousand. Tiles of various kinds and forms are made of finer materials, but by the same system of moulding. Amongst the ruins of the city of Gour, the ancient capital of Bengal, are found bricks having projecting ornaments in high relief: these appear to have been formed in a mould, and subsequently glazed with a colored glaze. In Germany, also, brickwork has been executed with various ornaments. The cornice of the church of St. Stefano, at Berlin, is made of large blocks of brick moulded into the form required by the architect.

84. *Of Embossed China.*—Many of the forms given to those beautiful specimens of earthenware, which constitute the equipage of our breakfast and our dinner tables, are not capable of being executed in the lathe of the potter. The embossed ornaments on the edges of the plates, their polygonal shape, the fluted surface of many of the vases, would all be difficult and costly of execution by the hand; but they become easy and uniform in all their parts when made by pressing the soft material, out of which they are formed, into a hard mould. The care and skill bestowed on the preparation of that mould are repaid by the multitude it produces.

In many of the works of the china manufactory, one part only of the article is moulded—the upper surface of the plate, for example—whilst the under side is figured by the lathe. In some instances the handle, or only a few ornaments, are moulded, and the body of the work is turned.

85. *Glass Seals.*—The process of engraving upon gems is one requiring considerable time and skill. The seals thus produced can, therefore, never become common. Imitations, however, have been made of various degrees of resemblance. The color which is given to glass is, perhaps, the most successful part of the imitation. A small cylindrical rod of colored glass is heated in the flame of a blow-pipe, until the extremity becomes soft. The operator then pinches it between the ends of a pair of nippers, which are formed of brass, and on one side of which has been carved in relief the device intended for the seal. When care has been taken in heating the glass properly, and when the mould has been well finished, the seals thus produced are not bad imitations. By this system of copying they are so multiplied, that at Birmingham the more ordinary kinds are to be purchased at three-pence a dozen.

86. *Square Glass Bottles.*—The round forms which are usually given to vessels of glass are readily produced by the expansion of the air with which they are blown. It is, however, necessary in many cases to make bottles of a square form, and each capable of holding exactly the same quantity of fluid. It is also frequently desirable to have imprinted on them the name of the maker of the medicine or other liquid they are destined to contain. A mould of iron, or of copper, is provided, of the intended size, on the inside of which are engraved the names required. This mould, which is used in a hot state, opens into two parts, to allow the insertion of the round unfinished bottle, which is placed in it in a very soft state, before it is removed from the end of the iron tube with which it was blown. The mould is now closed, and by blowing strongly into the bottle the glass is forced against its sides.

87. *Wooden Snuff-Boxes.*—Snuff-boxes ornamented with devices, in imitation of carved work or of rose engine-turning, are sold at a price which proves that they are only imitations. The wood, or horn, out of which they are formed, is softened by long boiling in water, and whilst in this state it is forced in moulds of iron, or steel, on which are cut the requisite patterns, where it remains exposed to great pressure until it is dry.

88. *Horn Knife-Handles and Umbrella-Handles.*—The property which horn possesses of becoming soft by the action of water and heat, fits it for many useful purposes. It is pressed into moulds, and becomes embossed with figures in relief, adapted to the nature and use of the objects to which it is to be applied. If curved, it may be straightened; or if straight, it may be bent into any form which ornament or utility may require; and by the use of the mould these forms may be multiplied in endless variety. The commoner sorts of knives, the crooked handles for umbrellas, and a multitude of other articles to which horn is applied, attest the cheapness which the art of copying gives to the things formed of this material.

89. *Moulding Tortoise-Shell.*—The same principle is applied to things formed out of the shell of the turtle, or the land tortoise. From the greatly superior price of the raw material, this principle of copying is, however, more rarely employed upon it; and the few carvings which are demanded are usually performed by hand.

90. *Tobacco Pipe-Making.*—This simple art is almost entirely one of copying. The moulds are formed of iron, in two parts, each embracing one-half of the stem; the line of junction of these parts may generally be observed running lengthwise from one end of the pipe to the other. The hole passing to the bowl is formed by thrusting a long wire through the clay whilst it is enclosed in the mould. Some of the moulds have figures, or names, sunk in the inside. This gives a corresponding figure in relief upon the finished pipe.

91. *Embossing upon Calico.*—Calicoes of one color, but embossed all over with various raised patterns, although not much worn in this country, are in great demand in several foreign markets. This appearance is produced by passing them through a pair of rollers, on one of which is figured in intaglio the pattern to be transferred to the calico. The substance of the cloth is pressed very forcibly into the cavities thus formed, and preserves its figured appearance after considerable use.

92. *Embossing upon Leather.*—This art of copying from patterns previously engraved on steel rollers is, in most respects, similar to the preceding. The leather is forced into the cavities, and that part which is not opposite to any cavity is powerfully condensed between the rollers.

93. *Swaging.*—This is an art of copying practised by the smith. In order to fashion his iron and steel into the form demanded by his customers, he has small blocks of steel into which are sunk cavities of various shapes; these are called *swages*, and are generally in pairs. Thus, if he wants a round bolt, terminating in a cylindrical head of larger diameter, and having one or more projecting rims, he uses a corresponding *swaging-tool;* and having heated the end of his iron rod, and thickened it by a process which is technically called *upsetting*, he places its head upon one of the parts of the *swage;* and while an assistant holds the other part on the top of the hot iron, he strikes it several times with his hammer, occasionally turning the head one quarter round. The heated and softened iron is thus forced by the blows to assume the form of the mould into which it is impressed.

94. *Engraving by Pressure.*—This is one of

the most beautiful instances of the art of copying, carried to an almost unlimited extent; and the delicacy with which it can be executed, and the precision with which the finest traces of the graving tool can be transferred from steel to copper, or even from hard steel to soft steel, is most unexpected. We are indebted to Mr. Perkins for most of the contrivances which have brought this art at once almost to perfection. An engraving is first made upon soft steel, which is hardened by a peculiar process, without in the least injuring its delicacy. A cylinder of soft steel, pressed with great force against the hardened steel engraving, is now made to roll slowly backward and forward over it, thus receiving the design, but in relief. This is in its turn hardened without injury; and if it be slowly rolled to and fro with strong pressure on successive plates of copper, it will imprint on a thousand of them a perfect fac-simile of the original steel engraving from which it resulted. Thus the number of copies producible from the same design is multiplied a thousand-fold. But even this is very far short of the limits to which this process may be extended. The hardened steel-roller, bearing the design upon it in relief, may be employed to make a few of its first impressions upon plates of *soft steel*, and these being hardened become the representatives of the original engraving, and may in their turn be made the parents of other rollers, each generating copper-plates like their prototype. The possible extent to which fac-similes of one original engraving may thus be multiplied almost confounds the imagination, and appears to be for all practical purposes unlimited. There are two principles which peculiarly fit this art for rendering the forgery of bank notes (to prevent which it was proposed by Mr. Perkins) a matter of great difficulty. The first is the perfect identity of every impression with every other, so that any variation in the minutest line would at once cause detection. The other principle is, that the plates, from which all the impressions are derived, may be formed by the united labors of artists most eminent in their several departments; and as only one original of each design is necessary, the expense, even of the most elaborate engraving, will be trifling, compared with the multitude of copies produced from it.

95. It must, however, be admitted that the principle of copying itself furnishes an expedient for imitating any engraving or printed pattern, however complicated; and that it presents a difficulty which none of the schemes devised for the prevention of forgery appear to have yet effectually met. In attempting to imitate the most perfect bank note, the first process would be to place it with the printed side downwards, upon a stone or other substance, on which, by passing it through a rolling press, it might be firmly fixed. The next object would be to discover some solvent which should dissolve the paper, but neither affect the printing-ink nor injure the stone or substance on which it is impressed. Water does not seem to do this effectually, and perhaps weak alkaline or acid solutions would be tried. If, however, this could be fully accomplished, and if the stone or other substance used had those properties which enable us to print from it, then innumerable fac-similes of the note might be made, and the imitation would be complete. Porcelain biscuit, which has recently been used with a black lead pencil for memorandum books, seems, in some measure, adapted for such trials, since its porosity may be diminished to any extent by diminishing the dilution of the glazing applied to it.

96. *Gold and Silver Moulding.*—Many of the mouldings used by jewellers consist of thin slips of metal, which have received their form by passing between steel rollers, on which the pattern is embossed or engraved; thus taking a succession of copies of the devices intended.

97. *Ornamental Papers.*—Sheets of paper colored or covered with gold or silver leaf, and embossed with various patterns, are used for covering books, and for many ornamental purposes. The figures upon these are produced by the same process, that of passing the sheets of paper between engraved rollers.

OF COPYING BY STAMPING.

This mode of copying is extensively employed in the arts. It is generally executed by means of large presses worked with a screw and heavy fly-wheel. The materials on which the copies are impressed are most frequently metals, and the process is sometimes executed when they are hot, and in one case when the metal is in a state between solidity and fluidity.

98. *Coins and Medals.*—The whole of the coins which circulate as money are produced by this mode of copying. The screw-presses are either worked by manual labor, by water, or by steam power. The mint which was sent a few years since to Calcutta was capable of coining 200,000 pieces a day. Medals, which usually have their figures in higher relief than coins, are produced by similar means; but a single blow is rarely sufficient to bring them to perfection, and the compression of the metal which arises from the first blow renders it too hard to receive many subsequent blows without injury to the die. It is, therefore, after being struck, removed to a furnace, in which it is carefully heated red-hot and annealed, after which operation it is again placed between the dies; and receives additional blows. For large medals, and those on which the figures are very prominent, these processes must be repeated many times. One of the largest medals hitherto struck underwent them nearly a hundred times before it was completed.

99. *Ornaments for Military Accoutrements, and Furniture.*—These are usually made of brass, and are stamped up out of solid or sheet brass by placing it between dies, and allowing

a heavy weight to drop upon the upper die from a height of from five to fifteen feet.

100. *Buttons and Nail Heads.*—Buttons embossed with crests or other devices are produced by the same means; and some of those which are plain receive their hemispherical form from the dies in which they are struck. The heads of several kinds of nails which are portions of spheres, or polyhedrons, are also formed by these means.

101. *Of a Process for Copying, called in France Clichee.*—This curious method of copying by stamping is applied to medals, and in some cases to forming stereotype plates. There exists a range of temperature previous to the melting point, of several of the alloys of lead, tin, and antimony, in which the compound is neither solid, nor yet fluid. In this kind of pastry state it is placed in a box under a die, which descends upon it with considerable force. The blow drives the metal into the finest lines of the die, and the coldness of the latter immediately solidifies the whole mass. A quantity of the half melted metal is driven about by the blow in all directions, and is retained by the sides of the box in which the process is carried on. The work thus produced is admirable for its sharpness, but has not the finished form of a piece just leaving the coining-press; the sides are ragged, and it must be trimmed, and its thickness equalized in the lathe.

OF COPYING BY PUNCHING.

102. This mode of copying consists in driving, either by a blow or by pressure, a steel punch through the substance to be cut. In some cases the object is to make repeated copies of the same aperture, and the substance separated from the plate is rejected; in other cases it is the small pieces cut out which are the objects of the workman's labor.

103. *Punching Iron Plate for Boilers.*—The steel punch used for this purpose is from three-eighths to three-quarters of an inch in diameter, and drives out from a plate of iron a circular disk from one-fourth to five-eighths of an inch thick.

104. *Punching Tinned Iron.*—The ornamental patterns of open work, which decorate the tinned and japanned wares in general use, are rarely punched by the workman who makes them. In London, the art of punching out these patterns in screw-presses is carried on as a separate trade; and large quantities of sheet tin are perforated for cullenders, wine-strainers, borders of waiters, and other similar purposes. The perfection and regularity to which the art has been carried are remarkable. Sheets of copper, too, are punched with small holes about the hundredth of an inch in diameter, in such multitudes that more of the sheet of metal is removed than remains behind; and plates of tin have been perforated with above three thousand holes in each square inch.

105. The inlaid plates of brass and rosewood, called *buhl work*, which ornament our furniture, are formed by punching; but in this instance, both the parts cut out and those which remain are in many cases employed. In the remaining illustrations of the art of copying by punching, the part used is that which is punched out.

106. *Cards for Guns.*—The substitution of a circular disk of thin card instead of paper, for retaining in its place the charge of a fowling-piece, is attended with considerable advantage. It would, however, be of little avail, unless an easy method was contrived of producing an unlimited number of cards, each exactly fitting the bore of the barrel. The small steel tool used for this purpose cuts out innumerable circles similar to its cutting end, each of which precisely fills the barrel for which it was designed.

107. *Ornaments of Gilt Paper.*—The golden stars, leaves, and other devices, sold in shops for the purpose of ornamenting articles made of paper and paste-board, and other fancy works, are cut by punches of various forms, out of sheets of gilt paper.

108. *Steel Chains.*—The chain used in connecting the main-spring and fusee in watches and clocks is composed of small pieces of sheet steel. It is of great importance that each of these pieces should be of exactly the same size. The links are of two sorts; one of them consisting of a single oblong piece of steel with two holes in it, and the other formed by connecting two of the same pieces of steel, placed parallel to each other, at a short distance, by two rivets. These two kinds of links occur alternately; and the single piece, which forms one of them, has each end placed between the ends of the adjacent double pieces, with which it is connected by the rivets passing through all three. If the double pieces had the holes for the rivets placed at unequal distances, the chain would not be straight, and would, consequently, be unfit for its purpose.

COPYING WITH ELONGATION.

109. In this species of copying there exists but little resemblance between the copy and the original. It is the cross section of the thing produced, which is similar to the tool through which it passes. When the substances to be operated upon are hard, they frequently pass in succession thro' several holes, and it is in some cases necessary to anneal them at intervals.

110. *Wire drawing.*—The metal to be converted into wire is made of a cylindrical form, and drawn forcibly through circular holes in plates of steel: at each passage it becomes smaller; and when finished, its section at any point is a precise copy of the last hole through which it passed. Upon the larger kinds of wire, fine lines may frequently be traced, running longitudinally; these arise from a slight imperfection in the holes of the draw-plates. For many purposes of the arts, wire, the section of which is square or half round, is required: the same method of making it is pur-

sued, except that the holes through which it is drawn are in such cases themselves square, or half round, or of whatever other form the wire is required to be. A species of wire is made, the section of which resembles a star with from six to twelve rays; this is called pinion wire, and is used by the clock-makers. They file away all the rays from a short piece, except from about half an inch near one end: this becomes a pinion for a clock; and the leaves or teeth, having passed through the *draw-plate*, are already burnished and finished.

111. *Tube drawing.*—The art of forming tubes of uniform diameter is nearly similar in its mode of execution to wire drawing. After the sheet-brass has been bent round and soldered so as to form a hollow cylinder, if the outside diameter is that which is required to be uniform, it is drawn through a succession of holes as in wire drawing. If the inside diameter is to be uniform, a succession of steel cylinders, called *triblets*, are drawn through the brass tube. In making tubes for telescopes, it is necessary that both the inside and outside should be uniform. A steel *triblet* is passed into the tube, which is then drawn through a succession of holes, until the outside diameter is reduced to the required size. The metal of which the tube is formed is condensed between the holes, and the steel cylinder within it; and when the latter is withdrawn the internal surface appears polished. The brass tube is considerably extended by this process, sometimes even to double its first length.

112. Leaden pipes for the conveyance of water were formerly made by casting; but it has been found that they can be made both cheaper and better by drawing them through holes in the manner of wire. A cylinder of lead, of five or six inches in diameter, and about two feet long, is cast with a small hole through its axis, and an iron *triblet* of fifteen feet in length is forced into the hole. It is then drawn through a series of holes, until the lead has extended from one end to the other of the *triblet*, and is of the proper thickness in proportion to the size of the pipe.

113. *Iron rolling.*—When cylinders of iron of greater thickness than wire are required, they are formed by passing wrought iron between rollers, each of which has sunk in it a semi-cylindrical groove; and as such rollers rarely touch accurately, a longitudinal line will usually be observed in iron so manufactured. Bar iron is thus shaped into all the various forms of round, square, half-round, oval, &c., in which it occurs in commerce. A particular species of moulding is thus made, which resembles in its section that part of the frame of a window which separates two adjacent panes of glass. Being much stronger than wood, it can be considerably reduced in thickness, and consequently offers less obstruction to the light: it is much used for sky-lights.

114. It is sometimes required that the iron thus produced shall not be of uniform thickness throughout. This is the case in rolling iron for railroads, for which purpose greater depth is required towards the middle of the rail, which is at the greatest distance from the supports. This is accomplished by cutting the groove in the rollers deeper at those parts where additional strength is required, so that the hollow which surrounds the roller would, if it could be unwound, be a mould of the shape the iron is intended to fit.

115. *Vermicelli.*—The various forms into which this paste is made are given by forcing it through holes in tin plate. It passes through them, and appears on the other side in long strings. The cook and the confectioner make use of the same method; the former in preparing butter and ornamental pastry for the table, the latter in forming the cylindrical lozenges of various composition.

OF COPYING WITH ALTERED DIMENSIONS.

116. *Of the Pentagraph.*—This mode of copying is chiefly used for drawings or maps: the instrument is simple; and, although usually employed in reducing, is capable of enlarging the size of the copy produced. An automaton figure, which drew profiles of its visiters, and which was exhibited in London a short time since, was regulated by a mechanism on this principle. A small aperture in the wall, opposite the seat in which the person is placed whose profile is taken, conceals a camera lucida. If an assistant moves a point, connected by a pentagraph with the hand of the automaton, over the outline of the head, a corresponding profile is traced by the figure.

117. *By turning.*—The art of turning might perhaps itself be classed amongst the arts of copying. A steel axis, called a *mandril*, having a pulley attached to the middle of it, is supported at one end either by a conical point, or by a cylindrical collar, and at the other end by another *collar*, through which it passes. The extremity which projects beyond this last *collar* is formed into a screw, by which various instruments, called *chucks*, are attached to it. These *chucks* are intended to hold the various materials to be submitted to the operation of turning, and have a great variety of forms. The *mandril* is made to revolve by a strap which passes over the pulley that is attached to it, and likewise over a larger wheel moved either by the foot, or by its connection with steam or water power. All work which is executed on a *mandril* partakes in some measure of the irregularites of that *mandril;* and the perfect circularity of section which ought to exist at every part can only be insured by an equal accuracy in the *mandril* and its *collar.*

118. *Rose Engine-turning.*—This elegant art depends in a great measure on copying. The *rosettes*, or circular plates of metal, having various indentations on the faces or edges which are placed on the mandril, oblige the cut-

ting tool to trace out the same pattern on the work, and the distance of the cutting tool from the centre being usually less than the radius of the *rosette*, causes the copy to be much diminished.

119. *Copying Dies.*—A lathe has been long known in France, and recently been used at the English mint, for copying dies. A blunt point is carried by a very slow spiral movement successively over every part of the die to be copied, and is pressed by a weight into all the cavities; while a cutting point connected with it by the machine traverses the face of a piece of soft steel, in which it cuts on the same, or on a diminished scale, the device on the original die. The degree of excellence of the copy increases in proportion as it is smaller than the original. The die of a crown-piece will furnish by copy a very tolerable die for a sixpence. But the chief use to be expected from this lathe is to prepare all the coarser parts, and leave only the finer and more expressive lines for the skill and genius of the artist.

120. An instrument not very dissimilar in principle to this was proposed for the purpose of making shoe lasts. A pattern last of a shoe for the right foot was placed in one part of the apparatus, and when the machine was moved, two pieces of wood, placed in another part which had been previously adjusted by screws, were cut into lasts greater or less than the original, as was desired; and although the pattern was for the right foot, one of the lasts was for the left, an effect which was produced by merely interposing between the two pieces to be cut into lasts a wheel which reversed the motion.

121. *Engine for copying Busts.*—Many years since, the late Mr. Watt amused himself with constructing an engine to produce copies of busts or statues, either of the same size as the original, or in a diminished proportion. The substances on which he operated were various, and some of the results were shown to his friends, but the mechanism by which they were made has never been described. More recently, Mr. Hawkins, who had also contrived several years ago a similar machine, has placed it in the hands of an artist, who has made copies in ivory of a variety of busts. The art of multiplying in *different sizes* the figures of the sculptor, aided by that of rendering their acquisition cheap through the art of casting, promises to give additional value to his productions, and to diffuse more widely the pleasure arising from their possession.

122. *Screw-cutting.*—When this operation is performed in the lathe by means of a screw upon the *mandril,* it is essentially an art of copying, but it is only the number of threads in a given length which is copied; the *form* of the thread and length, as well as the diameter of the screw to be cut, are entirely independent of those from which the copy is made. There is another method of cutting screws in a lathe by means of one pattern screw, which, being connected by wheels with the *mandril,* guides the cutting point. In this process, unless the time of revolution of the *mandril* is the same as that of the screw which guides the cutting point, the number of threads in a given length will be different. If the *mandril* move quicker than the cutting-point, the screw which is produced will be finer than the original; if it move slower, the copy will be more coarse than the original. The screw thus generated may be finer or coarser—it may be larger or smaller in diameter—it may have the same or a greater number of threads than that from which it is copied; yet all the defects which exist in the original will be accurately transmitted under the modified circumstances to every individual generated from it.

123. *Printing from Copper-Plates with altered Dimensions.*—Some very singular specimens of an art of copying, not yet made public, were brought from Paris a few years since. A watch-maker in that city, of the name of Gonord, had contrived a method by which he could take from the same copper-plate impressions of different sizes, either larger or smaller than the original design. Having procured four impressions of a parrot, surrounded by a circle, executed in this manner, I showed them to the late Mr. Lowry, an artist equally distinguished by his skill, and for the many mechanical contrivances with which he enriched his art. The relative dimensions of the several impressions were 5·5, 6·3, 8·4, 15·0, so that the largest was nearly three times the linear size of the smallest; and Mr. Lowry assured me, that he was unable to detect any lines in one which had not corresponding lines in the others. There appeared to be a difference in the quantity of ink, but none in the traces of the engraving; and, from the general appearance, it was conjectured that the largest but one was the original impression from the copper-plate. The processes by which this singular operation was executed have not been published; but two conjectures were formed at the time which merit notice. It was supposed that the artist was in possession of some method of transferring the ink from the lines of the copper-plate to the surface of some fluid, and of re-transferring the impression from the fluid to paper. If this could be accomplished, the print would be exactly the same size as the copper from which it was derived; but if the fluid were contained in a vessel having the form of an inverted cone, with a small aperture at the bottom, the liquid might be lowered or raised in the vessel by gradual abstraction or addition through the apex of the cone; in this case, the surface to which the printing-ink adhered would diminish or enlarge, and in this altered state the impression might be re-transferred to paper. It must be admitted, that this conjectural explanation is liable to very considerable difficulties; for although the converse operation of taking an impression from a liquid surface has a parallel in the art of marbling paper, the possibility of transferring the ink from the copper to the fluid requires to be proved. Another and more

plausible explanation is founded on the elastic nature of the compound of glue and treacle, a substance already in use in transferring engravings to earthenware. It is conjectured, that an impression from the copper-plate is taken upon a large sheet of this composition; that this sheet is then stretched in both directions, and that the ink thus expanded is transferred to paper. If the copy is required to be smaller than the original, the elastic substance must first be stretched, and then receive the impression from the copper-plate: on removing the tension it will contract, and thus reduce the size of the design. It is possible that one transfer may not in all cases suffice; as the extensibility of the composition of glue and treacle, although considerable, is still limited. Perhaps sheets of India rubber of uniform texture and thickness may be found to answer better than this composition; or possibly the ink might be transferred from the copper-plate to the surface of a bottle of this gum, which bottle might, after being expanded by forcing air into it, give up the enlarged impression to paper. As it would require considerable time to produce impressions in this manner, and there might arise some difficulty in making them all of precisely the same size, the process might be rendered more certain and expeditious by performing that part of the operation which depends on the enlargement or diminution of the design only once; and, instead of printing from the soft substance, transferring the design from it to stone: thus a considerable portion of the work would be reduced to an art already well known, that of lithography. This idea receives some confirmation from the fact, that in another set of specimens, consisting of a map of St. Petersburg, of several sizes, a very short line, evidently an accidental defect, occurs in all the impressions of one particular size, but not in any of a different size.

124. *Machine to produce Engravings from Medals.*—An instrument was contrived a long time ago, and is described in the *Manuel de Tourneur*, by which copper-plate engravings are produced from medals and other objects in relief. The medal and the copper are fixed on two sliding plates at right angles to each other, so connected that when the plate on which the medal is fixed is raised vertically by a screw, the slide holding the copper-plate is advanced by an equal quantity in the horizontal direction. The medal is fixed on the vertical slide with its face opposite the copper-plate, and a little above it.

A bar, terminating at one end in a tracing-point, and at the other by a short arm, at right angles to the bar, and holding a diamond-point, is placed horizontally above the copper, so that the tracing-point shall touch the medal to which the bar is perpendicular, and the diamond-point shall touch the copper-plate to which the arm is perpendicular.

Under this arrangement, if the bar is moved always parallel to itself, and consequently to the copper, while the tracing-point is kept in contact with the medal, then if the tracing-point pass over a flat part of the medal, the diamond-point will draw a straight line of equal length upon the copper; but, if the tracing-point pass over any projecting part of the medal, the deviation from the straight line by the diamond-point will be exactly equal to the elevation of the corresponding point of the medal above the rest of the surface. Thus, by the transit of this tracing-point over any segment of the medal, the diamond will draw upon the copper a section of the medal through that plane.

A screw is attached to the apparatus, so that if the medal be raised a very small quantity by the screw, the copper-plate will be advanced by the same quantity, and thus a new line of section may be drawn: and, by continuing this process, the series of sectional lines on the copper produce the representation of the medal on a plane; the outside and the form of the figure arising from the sinuosities of the lines, and from their greater or less proximity. The effect of this kind of engraving is very striking; and in some specimens gives a high degree of apparent relief. It has been practised on plate glass, and is then additionally curious from the circumstance of the fine lines traced by the diamond being invisible, except in certain lights.

From this description it will be seen that the engraving on the copper must be distorted; that is to say, that the apparent projection on the copper will not be the same as that which arises from a perpendicular projection of each point of the medal upon a plane parallel to itself. Consequently, the position of the prominent parts will be more altered than that of the less elevated; and the greater the relief of the medal the more distorted will be its engraved representation. Mr. John Bate, son of Mr. Bate, of the Poultry, has contrived an improved machine, for which he has taken a patent, in which this source of distortion is remedied.

The inconvenience which arises from too high a relief in the medal, or in the bust, might be remedied by some mechanical contrivance, by which the deviation of the diamond-point from the right line, (which it would describe when the tracing-point traverses a plane,) is made proportional—not to the elevation of the corresponding point above the plane of the medal, but above some other parallel plane removed to a fit distance behind it. Thus busts and statues might be reduced to any required degree of relief.

125. The machine just described naturally suggests other views which seem to deserve consideration, and, perhaps, some experiment. If a medal were placed under the tracing-point of a pentagraph, an engraving tool substituted for the pencil, and a copper-plate in the place of the paper: and if, by some mechanism, the tracing-point, which slides in a vertical plane as it is carried over the different elevations of

the medal, could increase or diminish the depth of the engraved line proportionally to the actual height of the corresponding point on the medal, then an engraving would be produced, free at least from any distortion, although it might be liable to objections of a different kind. If, by any similar contrivance, instead of lines, we could make on each point of the copper a dot, varying in size or depth with the altitude of the corresponding point of the medal above its plane, then a new species of engraving would be produced; and the variety of these might again be increased, by causing the graving point to describe a very small circle of a diameter, varying with the height of the point on the medal above a given plane, or by making the graving-tool consist of three equi-distant points, whose distance increased or diminished according to some determinate law, dependant on the elevation of the point represented above the plane of the medal. It would, perhaps, be difficult to imagine the effects of some of these kinds of engravings; but they would all possess, in common, the property of being projections, by parallel lines, on the objects represented, and the intensity of the shade of the ink would either vary according to some function of the distance of the point represented from some given plane, or it would be a little modified by the distances from the same plane of a few of the immediate contiguous points.

126. *Lace made by Caterpillars.*—A most extraordinary species of manufacture, which is in a slight degree connected with copying, has been contrived by an officer of engineers, residing at Munich. It consists of lace, and veils, with open patterns in them, made entirely by caterpillars. The following is the mode of proceeding adopted :—Having made a paste of the leaves of the plant, on which the species of caterpillar he employs feeds, he spreads it thinly over a stone, or other flat substance, of the required size. He then, with a camel-hair pencil dipped in olive oil, draws the pattern he wishes the insects to leave open. This stone is then placed in an inclined position, and a considerable number of the caterpillars are placed at the bottom. A peculiar species is chosen, which spins a strong web; and the animals commence at the bottom, eating and spinning their way up to the top, carefully avoiding every part touched by the oil, but devouring every other part of the paste. The extreme lightness of these veils, combined with some strength, is truly surprising. One of them, measuring twenty-six and a half inches by seventeen inches, weighed only 1·51 grains, a degree of lightness which will appear more strongly by contrast with other fabrics. One square yard of the substance of which these veils are made, weighs four grains and one third, whilst one square yard of silk gauze weighs one hundred and thirty-seven grains, and one square yard of the finest patent net weighs two hundred and sixty-two grains and a half. The ladies' colored muslin dresses, mentioned in the table subjoined, cost ten shillings per dress, and each weighs six ounces; the cotton from which they are made weighing nearly six and two-ninths ounces avoirdupois weight.

Weight of one square yard of each of the following articles* :

Description of Goods.	Value per yard meas. s.	d.	Weight finished of one sq. yd. Troy grs.	Weight of cott'n used in making one sq. yd. Troy grs.
Caterpillar Veils,	-	-	$4\frac{1}{3}$	-
Silk Gauze $\frac{3}{4}$ wide,	1	0	137	-
Finest Patent Net,	-	-	$262\frac{1}{2}$	-
Fine Cambric Muslin,	-	-	551	-
6-4ths Jaconet Muslin,	2	0	613	670
Ladies' colored Muslin Dresses,	3	0	788	875
6-4ths Cambric,	1	2	972	1069
9-8ths Calico,	0	9	988	1085
1-2 yard Nankeen,	0	8	2340	2432

127. This enumeration, which is far from complete, of the arts in which copying is the foundation, may be terminated with an example which has long been under the eye of the reader; although few, perhaps, are aware of the number of repeated copyings of which these pages are the subject.

1. They are copies, by printing, from stereotype plates.

2. These stereotype plates are copied by casting the plaster in a liquid state upon the moveable types set up by the compositor.

[It is here that the union of the intellectual and the mechanical department takes place. The mysteries, however, of an author's copying form no part of our inquiry, although it may be fairly remarked that, in numerous instances, the mental far eclipses the mechanical copyist.]

4. These moveable types, the obedient messengers of the most opposite thoughts, the most conflicting theories, are themselves copies by casting from moulds of copper called *matrices.*

5. The lower part of these *matrices,* bearing the impressions of the letter or character intended, are copies, by punching, from steel punches on which the same character exists in relief.

6. These steel punches are not themselves entirely exempted from the great principle of art. Many of the cavities which exist in them, such as those in the middle of the punches for the letters *a, b, d, e, g,* &c., are produced from other steel punches, in which these parts are in relief.

We have thus traced through six successive stages of copying the mechanical art of printing from stereotype plates; the principle of copying contributing in this, as in every other department of manufacture, to the uniformity and the cheapness of the work produced.

* Some of these weights and measures are calculated from a statement in the Report of the Committee of the House of Commons on Printed Cotton Goods, and the widths of the pieces there given are presumed to be the real widths, not those by which they are called in the retail shops.

ON THE METHOD OF OBSERVING MANUFACTORIES.

128. Having now reviewed the *mechanical* principles which regulate the successful application of mechanical science to great establishments for the production of manufactured goods, it remains for us to suggest a few inquiries, and to offer a few observations to those whom an enlightened curiosity may lead to examine the factories of this or of other countries.

The remark—that it is important to commit to writing all information as soon as possible after it is received, especially when numbers are concerned—applies to alm all inquiries. It is frequently impossible to do this at the time of visiting an establishment, although not the slightest jealousy may exist; the mere act of writing information as it is communicated orally, is a great interruption to the examination of machinery. In such cases, therefore, it is advisable to have prepared beforehand the questions to be asked, and to leave blanks for the answers, which may be quickly inserted, as, in a multitude of cases, they are merely numbers. Those who have not tried this plan will be surprised at the quantity of information which may, through its means, be acquired, even by a short examination. Each manufacture requires its own list of questions, which will be better drawn up after the first visit. The following outline, which is very generally applicable, may suffice for an illustration; and, to save time, it may be convenient to have it printed, and to bind up, in the form of a pocket-book, a hundred copies of the skeleton forms for processes, with about twenty of the general inquiries.

General Inquiries.—Outlines of a Description of any of the Mechanical Arts ought to contain Information on the following points:

Brief sketch of its history, particularly the date of its invention and its introduction into England.

Short reference to the previous state through which the material employed has passed; the places whence it is procured; the price of a given quantity.

The various processes must now be described successively, according to the plan which will be given in Sec. 129; after which the following information should be given:

Are various kinds of the same article made in one establishment or at different ones, and are there differences in the processes?

To what defects are the goods liable?

What substitutes or adulterations are used?

What waste is allowed by the master?

What tests are there of the goodness of the manufactured article?

The weight of a given quantity, or number, and a comparison with that of the raw material.

The wholesale price at the manufactory £ *s.* *d.* per

The usual retail price £ *s.* *d.* per

Who provide tools? Master, or men? Who repair tools? Master, or men?

What is the expense of the machinery?

What is the annual wear and tear, and what its duration?

Is there any particular trade for making it? Where?

Is it made and repaired at the manufactory?

In any manufactory visited, state the number ( ) of processes, and of the persons employed in each process, and the quantity of manufactured produce.

What quantity is made annually in Great Britain?

Is the capital invested in manufactories large or small?

Mention the principal seats of this manufacture in England; and if it flourishes much abroad, the places where it is established.

The duty, excise, or bounty, if any, should be stated, and any alterations in past years; and also the amount exported or imported for a series of years.

Whether the same article, but of superior, equal, or inferior make, is imported?

Does the manufacturer export, or sell to a middle-man, who supplies the merchant?

To what countries is it chiefly sent—and in what goods are the returns made?

129. Each process requires a separate skeleton, and the following outline will be sufficient for many different manufactories:

Process ( ) Manufacture ( )
Place ( ) Name ( )
date 183

The mode of executing it, with sketches of the tools or machine, if necessary.

The number of persons necessary to attend the machine.

Are the operatives men, ( ) women, ( ) or children ( )? If mixed, what are the proportions?

What is the pay of each? (*s.* *d.*) (*s.* *d.*) (*s.* *d.*) per

What number ( ) of hours do they work per day?

Is it usual, or necessary, to work night and day without stopping?

Is the labor performed by piece or by day-work?

Who provide tools? Master, or men? Who repair tools? Master, or men?

What degree of skill is required, and how many years ( ) apprenticeship?

The number of times ( ) the operation is repeated per day or per hour.

The number of failures ( ) in a thousand.

Whether the workman or the master loses by the broken or damaged articles?

What is done with them?

If the same process is repeated several times, state the diminution or increase of measure, and the loss, if any, at each repetition.

130. In using this skeleton, the answers to the questions are in some cases printed, as—

Who repair tools? Masters, Men: in order that the proper answer may be underlined with a pencil. In filling up the answers which require numbers, some care should be taken; for instance, if the observer stands with his watch in his hand before a person heading a pin, the workman will almost certainly increase his speed, and the estimate will be too large. A much better average will result from inquiring what quantity is considered a fair day's work. When this cannot be ascertained, the number of operations performed in a given time may frequently be ascertained when the workman is quite unconscious that any person is observing him. Thus, the sound made by the motion of a loom may enable the observer to count the number of strokes per minute, even though he is outside the building in which it is contained. M. Coulomb, who had great experience in making such observations, cautions those who may repeat his experiments against being deceived by such circumstances: "Je prie (says he) ceux qui voudront les repeter, s'ils n'ont pas le temps de mesurer les resultats apres plusieurs jours d'un travail continu, d'observer les ouvriers à differentes reprises dans la journee, sans qu'ils sachent qu'ils sont observes. L'on ne peut trop avertir combien l'on risque de se tromper en calculant, soit la vitesse, soit le temps effectif du travail, d'apres une observation des quelques minutes." (*Memoires de l'Institut. Tom. II. p.* 247.)—It frequently happens, that, in a series of answers to such questions, there are some which, although given directly, may also be deduced by a short calculation from others that are given or known; and advantage should always be taken of these verifications, in order to confirm the accuracy of the statements; or, in case they are discordant, to correct the apparent anomalies. In putting lists of questions into the hands of persons undertaking to give information upon any subject, it is in some cases desirable to have an estimate of the soundness of his judgment. The questions can frequently be so shaped that some of them may indirectly depend on others; and one or two may be inserted whose answers can be obtained by other methods; nor is this process without its advantages in enabling us to determine the value of our own judgment. The habit of forming an estimate of the magnitude or frequency of any object immediately previous to our applying to it measure or number, tends materially to fix our attention and to improve our judgment.

DISTINCTION BETWEEN MAKING AND MANUFACTURING.

131. The *economical principles* which regulate the application of machinery, and which govern the interior of all our great factories, are quite as essential to the prosperity of a great commercial country as are those mechanical principles, the operations of which have been illustrated in the preceding section.

The first object of every person who attempts to make any article of consumption, is, or ought to be, to produce it in a perfect form; but in order to secure to himself the greatest and most permanent profit, he must endeavor by every means in his power to render the new luxury or want, which he has created, cheap to those who consume it. The larger number of purchasers thus obtained will, in some measure, secure him from the caprices of fashion, whilst it furnishes a far greater amount of profit, although the contribution of each individual is diminished. The importance of collecting data for the purpose of enabling the manufacturer to ascertain how many additional customers he will acquire by a given reduction in the price of the article he makes, cannot be too strongly pressed upon the attention of those who employ themselves in statistical inquiries. In some ranks of society, any diminution of price in a commodity will bring forward but few additional customers; whilst, in other classes, a very small reduction will so enlarge the sale as to yield a considerable increase of profit.

132. If, therefore, the *maker* of an article wish to become a *manufacturer* in the more extended sense of the term, he must attend to other principles besides those mechanical ones on which the successful execution of his work depends; and he must carefully arrange the whole system of his factory in such a manner, that the article he sells to the public may be produced at as small a cost as possible. Should he not be actuated at first by motives so remote, he will, in every highly civilized country, be compelled, by the powerful stimulus of competition, to attend to the principles of the domestic economy of manufactures. At every reduction in price of the commodity he makes, he will be driven to seek compensation in a saving of expense in some of the processes; and his ingenuity will be sharpened in this inquiry by the hope of being able in his turn to undersell his rivals. The benefit of the improvements thus engendered is, for a short time, confined to those from whose ingenuity they derived their origin; but when a sufficient experience has proved their value, they become generally adopted, until in their turn they are superseded by other more economical methods.

133. There exists a considerable difference between the terms *making* and *manufacturing*. The former refers to the production of *a small*, the latter to that of *a very large number of individuals*; and the difference is well illustrated in the evidence given before the Committee of the House of Commons on the Export of Tools and Machinery. On that occasion Mr. Maudslay stated, that he had been applied to by the Navy Board to make iron tanks for ships, and that he was rather unwilling to do so, as he considered it to be out of his line of business; however, he undertook to make one as a trial. The holes for the rivets were punched by hand-punching with presses, and the 1680 holes

which each tank required, cost seven shillings. The Navy Board, who required a large number, proposed that he should supply forty tanks a week for many months. The magnitude of the order made it worth while to commence *manufacturer*, and to make tools for the express business. Mr. Maudslay, therefore, offered, if the Board would give him an order for two thousand tanks, to supply them at the rate of eighty per week. The order was given: he made tools, by which the expense of punching the rivet-holes of each tank was reduced from seven shillings to nine-pence; he supplied ninety-eight tanks a week for six months, and the price charged for each was reduced from seventeen pounds to fifteen.

ON THE INFLUENCE OF VERIFICATION ON PRICE.

134. The money price of an article at any given period is usually stated to depend upon the proportion between the supply and the demand. The average price of the same article during a long period is said to depend, ultimately, on the power of producing and selling it with the ordinary profits of capital. But these principles, although true in their general sense, are yet so often modified by the influence of others, that it becomes necessary to examine a little into the disturbing forces.

135. With respect to the first of these propositions, it may be observed that the cost of any article to the purchaser includes, besides supply and demand, another element, which, though often of little importance, is in many cases of great consequence. The cost, to the purchaser, is the price he pays for any article, added to the cost of verifying the fact of its having that degree of goodness for which he contracts. In some cases the goodness of the article is evident on mere inspection; and in these cases there is not much difference of price at different shops. The goodness of loaf-sugar, for instance, can be discerned almost at a glance; and the consequence is, that the price of it is so uniform, and the profit upon it so small, that no grocer is at all anxious to sell it: whilst, on the other hand, tea, of which it is exceedingly difficult to judge, and which can be adulterated by mixture so as to deceive the skill even of a practiced eye, has a great variety of different prices, and is that article which every grocer is most anxious to sell to his customers. The difficulty and expense of verification are, in some instances, so considerable, as to justify the deviation from well established principles. Thus, it has been found so difficult to detect the adulteration of flour, and to measure its good qualities, that, contrary to the maxim that *government* can generally purchase any article at a cheaper rate than that at which they can manufacture it, it has been considered more economical to build extensive flour-mills, (such as those at Deptford,) and to grind their own corn, than to verify each sack purchased, and to employ persons in continually devising methods of detecting the new modes of adulteration which might be resorted to.

136. Some years since, a mode of preparing old clover and trefoil seeds by a process called "*doctoring*" became so prevalent as to excite the attention of the House of Commons. It appeared in evidence before a committee, that the old seed of the white clover was *doctored* by first wetting it slightly, and then drying it with the fumes of burning sulphur; and that the red clover seed had its color improved by shaking it in a sack with a small quantity of indigo; but this being detected after a time, the *doctors* then used a preparation of logwood, fined by a little copperas, and sometimes by verdigris; thus at once improving the appearance of the old seed, and diminishing, if not destroying, its vegetative power already enfeebled by age. Supposing no injury had resulted to good seed so prepared, it was proved that, from the improved appearance, its market price would be enhanced by this process from five to twenty-five shillings a hundred weight. But the greatest evil arose from the circumstance of these processes rendering old and worthless seed, in appearance, equal to the best. One witness tried some *doctored* seed, and found that not above one grain in a hundred grew, and that those which did vegetate died away afterwards; whilst about eighty or ninety per cent. of good seed usually grows. The seed so treated was sold to retail dealers in the country, who, of course, endeavored to purchase at the cheapest rate, and from them it got into the hands of the farmers; neither of these classes being at all capable of distinguishing the fraudulent from the genuine seed. Many cultivators, in consequence, diminished their consumption of the article; and others were obliged to pay a higher price to those who had skill to distinguish the mixed seed, and who had integrity and character to prevent them from dealing in it.

137. In the Irish flax trade, a similar example of the high price paid for verification occurs. It is stated in the report of the committee—"That the natural excellent quality of Irish flax, as contrasted with foreign or British, has been admitted." Yet from the evidence before that committee, it appears that Irish flax sells, in the market, from 1*d.* to 2*d.* per pound less than other flax of equal or inferior quality. Part of this difference of price arises from negligence in its preparation, but a part also from the expense of ascertaining that each parcel is free from stones and rubbish to add to its weight: this appears from the evidence of Mr. J. Corry, who was, during twenty-seven years, Secretary to the Irish Linen Board:

"The owners of the flax, who are almost always people in the lower classes of life, believe that they can best advance their own interests by imposing on the buyers. Flax being sold by weight, various expedients are used to increase it; and every expedient is injurious, particularly the damping of it,—a very common prac-

tice, which makes the flax afterwards heat. The inside of every bundle (and the bundles all vary in bulk) is often full of pebbles, or dirt of various kinds, to increase the weight. In this state it is purchased, and exported to Great Britain. The natural quality of Irish flax is admitted to be not inferior to that produced by any foreign country; and yet the flax of every foreign country, imported into Great Britain, obtains a preference among the purchasers, because the foreign flax is brought to the British market in a cleaner and more regular state. The extent and value of the sales of foreign flax in Great Britain can be seen by reference to the public accounts; and I am induced to believe, that Ireland, by an adequate extension of her flax tillage, and having her flax markets brought under good regulations, could, without encroaching in the least degree upon the quantity necessary for her home consumption, supply the whole of the demand of the British market, to the exclusion of the foreigners."

138. The lace trade affords other examples; and, in inquiring into the complaints made to the House of Commons by the frame-work knitters, the committee observe, that "It is singular that the grievance most complained of one hundred and fifty years ago, should, in the present improved state of the trade, be the same grievance which is now most complained of; for it appears, by the evidence given before your committee, that all the witnesses attribute the decay of the trade more to the making of fraudulent and bad articles, than to the war, or to any other cause." And it is shown by the evidence, that a kind of lace called "*single-press*" was manufactured, which was only looped once, and which, although good to the eye, became nearly spoiled in washing by the slipping of the threads; that not one person in a thousand could distinguish the difference between "*single-press*" and "*double-press lace*;" and that, even workmen and manufacturers were obliged to employ a magnifying glass for that purpose; and that, in another similar article, called "*warp lace*," such aid was essential. It was also stated by one witness, that

"The trade had not yet ceased, excepting in those places where the fraud had been discovered; and from those places no orders are now sent for any sort of Nottingham lace, the credit being totally ruined."

139. In the stocking trade similar frauds have been practised. It appeared in evidence, that stockings were made of uniform width from the knee down to the ankle, and being wetted and stretched on frames at the calf, they retained their shape when dry; but that the purchaser could not discover the fraud, until, after the first washing, the stocking appeared to hang like a bag about his ankles.

140. In the watch trade, the practice of deceit, in forging the marks and names of respectable makers, has been carried to a great extent both by natives and foreigners; and the effect upon our export trade has been most injurious, as the following extract from the evidence before a committee of the House of Commons will prove:

"*Question.*—How long have you been in the trade?

"*Answer.*—Nearly thirty years.

"*Question.*—The trade is at present much depressed?

"*Answer.*—Yes, sadly.

"*Question.*—What is your opinion of the cause of that distress?

"*Answer.*—I think it is owing to a number of watches that have been made so exceedingly bad that they will hardly look at them in the foreign markets; all with a handsome outside show, and the works hardly fit for any thing.

"*Question.*—Do you mean to say, that all the watches made in this country are of that description?

"*Answer.*—No; only a number which are made up by some of the Jews, and other low manufacturers. I recollect something of the sort years ago, of a fall-off of the East India work, owing to there being a number of handsome looking watches sent out, for instance, with hands on and figures, as if they showed seconds, and had not any regular work to show the seconds: the hand went round, but it was not regular.

"*Question.*—They had no perfect movements?

"*Answer.*—No, they had not; that was a long time since, and we had not any East India work for a long time afterwards."

In the home market, inferior but showy watches are made at a cheap rate, which are not warranted by the maker to go above half an hour: about the time occupied by the Jew pedlar in deluding his country customer.

141. The practice, in retail linen-drapers' shops, of calling certain articles yard-wide when the real width is, perhaps, only seven-eighths or three-quarters, arose at first from fraud, which being detected, custom was pleaded in its defence; but the result is, that the vender is constantly obliged to measure the width of his goods in the customer's presence. In all these instances, the object of the seller is to get a higher price than his goods would really produce if their quality were known; and the purchaser, if not himself a skilful judge (which rarely happens to be the case), must pay some person, in the shape of an additional money price, who has skill to distinguish, and integrity to furnish, articles of the quality agreed on. But as the confidence of persons in their own judgment is usually great, large numbers will always flock to the cheap dealer, who thus, attracting many customers from the honest tradesman, obliges him to charge a higher price for his judgment and character, than, without such competition, he could afford to do.

142. There are few articles which the public are less able to judge of than the quality of

drugs; and when they are compounded into medicines, it is scarcely possible, even for medical men, to decide whether pure or adulterated drugs have been employed. This circumstance, concurring with an injudicious mode adopted in the payment for medical assistance, has produced a curious effect on the price of medicines. Apothecaries, instead of being paid for their services and skill, have been remunerated by being allowed to place a high charge upon the medicines they administer, which are confessedly of very small pecuniary value. The tendency of such a system is to offer an inducement to prescribe more medicine than is necessary; and, in fact, even with the present charges, the apothecary, in ninety-nine cases out of a hundred, cannot be fairly remunerated unless the patient either takes, or pays for, more physic than is really necessary. The apparent extravagance of the charge of eighteen pence for a two-ounce phial* of medicine is obvious to many who do not reflect on the circumstance that the charge is, in reality, for the payment of professional skill. As the same charge is made by the apothecary, whether he attends the patient or merely prepares the prescription of a physician, the chemist and druggist soon offered to furnish the same commodity at a greatly diminished price. But the eighteen pence charged by the apothecary might have been fairly divided into two parts, three pence for medicine and bottle, and fifteen pence for attendance. Now the chemist, although he has reduced the price of the apothecary's draught, from thirty-three to forty-four per cent., yet realizes a profit of between two and three hundred per cent. on the ten pence or shilling he charges for the same compound. This enormous profit has called into existence a multitude of competitors; and in this instance the impossibility of verifying has, in a great measure, counteracted the beneficial effects of competition. The general adulteration of drugs, even at the extremely high price at which they are retailed as medicine, enables those who are imagined to sell them in an unadulterated state to make large profits, whilst the same evil frequently disappoints the expectation and defeats the skill of the most eminent physician.

It is difficult to point out a remedy for this evil without suggesting an almost total change in the system of medical practice. If the apothecary were to charge for his visits, and to reduce his medicines to one-fourth or one-fifth of their present price, he would still have an interest in procuring the best drugs, for the sake of his own reputation or skill. Or if the medical attendant, who is paid more highly for his time, were to have several pupils, he might himself supply the medicines without a specific charge, and his pupils would derive improvement from compounding them, as well as from examining the purity of the drugs he would purchase. The public would derive several advantages from this arrangement. In the first place, it would be greatly for the interest of the medical practitioner to have the best drugs; it would also be his interest not to give more physic than needful; and it would also enable him, through some of his more advanced pupils, to watch more frequently the changes of any malady.

143. The principle that *price*, at any moment, is dependent on the relation of the supply to the demand, is true to the full extent only when the whole supply is in the hands of a very large number of small holders, and the demand is caused by the wants of another set of persons, each of whom requires only the same very small quantity. And the reason appears to be, that it is only in such circumstances that a uniform average can be struck between the feelings, the passions, the prejudices, the opinions, and the knowledge, of both parties. If the supply, or present stock in hand, be entirely in the possession of one person, he will naturally endeavor to put such a price upon it as shall produce by its sale the greatest quantity of money; but he will be guided in this estimate of the price at which he will sell both by the knowledge that increased price will cause a diminished consumption, and by the desire to realize his profit before a new supply shall reach the market from some other quarter. If, however, the same stock is in the hands of several dealers, there will be an immediate competition between them, arising partly from their different views of the duration of the present state of supply, and partly from their own peculiar circumstances with respect to the employment of their capital.

144. Again, if the commodity itself is of a perishable nature, such, for example, as a cargo of ice imported into the port of London from Norway a few summers since, then time will supply the place of competition; and, whether the article is in the possession of one or of many persons, it will scarcely reach a monopoly price. The history of *cajeput oil*, during the last few months, offers a curious illustration of the effect of opinion upon price. In July of last year (1831) cajeput oil was sold, exclusive of duty, at 7*d.* per ounce. The disease which had ravaged the east was then supposed to be approaching our shores, and its proximity created alarm. At this period, the oil in question began to be much talked of as a powerful remedy in that dreadful disorder; and in September it rose to the price of 3*s.* and 4*s.* the ounce. In October there were few or no sales: but in the early part of November, the speculations in this substance reached their height, and between the 1st and the 15th it realized the following prices: 3*s.* 9*d.*, 5*s.*, 6*s.* 6*d.*, 7*s.* 6*d.*, 8*s.* 9*d.*, 10*s.*, 10*s.* 6*d.*, 11*s.* After the 15th of November, the holders of cajeput oil were anxious to sell at much

* Apothecaries frequently purchase these phials at the old bottle-warehouses at ten shillings per gross, so that when their servant has washed them the cost of the phial is nearly one penny.

lower rates; and in December a fresh arrival was offered by public sale at 5*s.*, and withdrawn, being sold afterwards, as it was understood, by private contract, at 4*s.* or 4*s.* 6*d.* per ounce. Since that time, 1*s.* 6*d.* and 1*s.* have been realized: and a fresh arrival, which is daily expected, (March, 1832,) will probably reduce it below the price of July. Now, it is important to notice that, in November, the time of greatest speculation, the quantity in the market was held by *few* persons, and that it frequently changed hands, each holder being desirous to realize his profit. The quantity imported since that time has also been considerable.*

145. The frequent speculations in oil, tallow, and other commodities, which must occur to the memory of most of my readers, were always founded on the principle of purchasing up all the stock on hand, and agreeing for the purchase of the expected arrivals; thus proving the opinion of capitalists to be, that a larger average price may be procured by the stock being held by few persons.

ON THE INFLUENCE OF DURABILITY ON PRICE.

146. Having now considered the circumstances that modify what may be called the momentary amount of price, we must next examine a principle which seems to have an effect on its permanent average. The durability of any commodity influences its cost in a permanent manner. We have already stated, that what may be called the *momentary price* of any commodity depends upon the proportion existing between the supply and demand, and also upon the cost of verification. The *average price*, during a long period, will depend upon the labor required for producing and bringing it to market, as well as upon the average supply and demand; but it will also be influenced by the *durability of the article manufactured.*

Many *things* in common use are substantially consumed in using: a phosphorus match, articles of food, and a cigar, are examples of this description. Some things after use become inapplicable to their former purposes, as paper which has been printed upon; but it is yet available for the cheesemonger or the trunkmaker. Some articles, as pens, are quickly worn out by use; and some are still valuable after a long-continued wear. There are others, few, perhaps, in number, which never wear out; the harder precious stones, when well cut and polished, are of this latter class; the fashion of the gold or silver mounting in which they are set may vary with the taste of the age, and such ornaments are constantly exposed for sale as second-hand, but the gems themselves, when removed from their supports, are never so considered. A brilliant, which has successively graced the necks of a hundred beauties, or glittered for a century upon patrician brows, is weighed by the diamond merchant in the same scale with another which has just escaped from the wheel of the lapidary, and will be purchased or sold by him at the same price per carat. The great mass of commodities is intermediate in its character between these two extremes, and the periods of respective duration are very various. It is evident that the average price of those things which are consumed in the act of using them, can never be less than that of the labor of bringing them to market. They may, for a short time, be sold for less; but under such circumstances their production must soon cease altogether. On the other hand, if an article never wears out, the consequence will be, that its price may continue *permanently below* the cost of the labor expended in producing it; and the only consequence will be, that no farther production will take place: its price will continue to be regulated by the relation of the supply to the demand; and should that at any after time rise, for a considerable period, above the cost of production, it will be again produced.

147. Articles become old from actual decay, or the wearing out of their parts; from improved modes of constructing them; or from changes in their form and fashion, required by the varying taste of the age. In the two latter cases, their utility is but little diminished; and, being less sought after by the classes who have hitherto employed them, they are sold at a reduced price to a class of society rather below that of their former possessors. Many articles of furniture, such as well-made tables and chairs, are thus found in the rooms of those who would have been quite unable to have purchased them when new; and we find constantly, even in the houses of the more opulent, large looking-glasses which have passed successively through the hands of several possessors, changing only the fashion of their frames; and in some instances even this alteration is omitted, an additional coat of gilding saving them from the character of being second-hand. Thus a taste for luxuries is propagated downwards in society; and, after a short period, the numbers who have acquired new wants become sufficient to excite the ingenuity of the manufacturer to reduce the cost of supplying them, whilst he is himself benefitted by the extended scale of demand.

There is a peculiarity in looking glasses with reference to the principle just mentioned. The most frequent occasion of injury to them arises from accidental violence; and the peculiarity is, that, unlike most other articles, when broken they are still of some value. If a large mirror is accidentally cracked, it is immediately cut into two or more smaller ones, each of which may be perfect. If the degree of violence is so great as to break it into many fragments, these smaller pieces may be cut into squares for dressing-glasses; and if the silvering is injured, it can either be re-silvered or used as plate-glass for glazing windows. The addition from our

* I have understood that the price of camphor, at the same time, suffered similar changes.